**STATE OF WASHINGTON**
**DEPARTMENT OF ECOLOGY**

| In the Matter of Remedial Action by: | AGREED ORDER |
|---|---|
| Grant County<br>and<br>The City of Ephrata | No. DE 3810 |

TO: Grant County
P.O. Box 37
Ephrata, WA 98823

City of Ephrata
121 Alder Street SW
Ephrata, WA 98823

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## I. INTRODUCTION

The mutual objective of the State of Washington, Department of Ecology (Ecology), Grant County (County), and the City of Ephrata (City) under this Agreed Order (Order) is to provide for remedial actions at a facility where there has been a release or threatened release of hazardous substances. This Order requires the County and the City to conduct a remedial investigation and feasibility study (RI/FS) to investigate the nature and extent of releases or threatened releases at the Ephrata Landfill and to propose cleanup options. The Order also requires the County and the City to conduct the following interim remedial actions: remove the approximately 2,000 drums of waste and the associated contaminated soils located in the northern portion of the landfill, extract and treat water from the area in the old landfill known as "the Hole", construct a final cover system over the waste disposal areas currently undergoing closure and manage landfill gas and control surface water during the RI/FS process. Ecology believes the actions required by this Order are in the public interest.

## II. JURISDICTION

This Agreed Order is issued pursuant to the authority of the Model Toxics Control Act (MTCA), RCW 70.105D.050(1).

## III. PARTIES BOUND

This Agreed Order shall apply to and be binding upon the Parties to this Order, their successors and assigns. The undersigned representative of each Party hereby certifies that he or she is fully authorized to enter into this Order and to execute and legally bind such Party to comply with the Order. The County and the City agree to undertake all actions required by the terms and conditions of this Order. The County and the City shall provide a copy of this Order to all agents, contractors, and subcontractors retained to perform work required by this Order, and shall ensure that all work undertaken by such agents, contractors, and subcontractors complies with this Order.

## IV. DEFINITIONS

Unless otherwise specified herein, the definitions set forth in Chapter 70.105D Revised Code Washington (RCW) and Chapter 173-340 Washington Administrative Code (WAC) shall control the meanings of the terms used in this Order.

1. Site: The Site is referred to as the Ephrata Landfill and is generally located at about three miles south of the City of Ephrata, east of Highway 28, in the western portion of Section 33, Township 21 North, Range 26 East, Willamette Meridian. The Site is defined by the extent of contamination caused by the release of hazardous substances at the Site.

2. Ephrata Landfill: The Ephrata Landfill or Landfill includes the waste management facilities at the Site and the property on which they are located. The legal description of the Landfill is attached as Exhibit A together with a drawing showing the location of the landfill facilities.

3. The Hole: The Hole is a subsurface depression in the basalt beneath the old landfill located in the northwest corner of the old landfill. It is 10 to 20 feet deep and about 450 feet in diameter. The bottom of the depression is filled with a sediment-refuse mix.

4. Parties: Refers to the State of Washington, Department of Ecology, Grant County, and the City of Ephrata.

5. PLP: Refers to the Potentially Liable Parties, Grant County, and the City of Ephrata.

6. Agreed Order or Order: Refers to this Order and each of the exhibits to the Order. All exhibits are integral and enforceable parts of this Order. The terms “Agreed Order” or “Order” shall include all exhibits to the Order.

## V. FINDINGS OF FACT

Ecology makes the following findings of fact, without any express or implied admissions of such facts by the PLPs:

1. The Ephrata Landfill is located about three miles south of the City of Ephrata on the east side of Highway 28 in the western portion of Section 33, Township 21 North, Range 26 East, Willamette Meridian.

2. The City of Ephrata began operating the Ephrata Landfill in approximately 1942 and owned and operated it until 1974. The City owned part of the property set aside for the landfill and leased additional property from the United States Bureau of Reclamation.

3. The landfill was operated as an open dump prior to 1962. The landfill operated continually as an unlined cell until a new lined cell was opened in 2005.

4. In 1974, the City and the County entered into the first of a series of agreements under which the County leased the landfill from the City and operated the facility. In 1990, the Bureau of Reclamation transferred its landfill property to the County. In 1994, the City deeded its landfill property to the County.

5. Approximately 2,000 drums of industrial waste were buried at the landfill in August 1975. In December 1975, the Grant County Health District stopped disposal of drums at the landfill due to health concerns.

6. The Site was added to the Environmental Protection Agency (EPA) list of potential hazardous sites in 1979.

7. Ecology submitted a Preliminary Assessment to the EPA in 1984 and recommended a follow-up Site Investigation. The EPA conducted a preliminary Site Investigation in 1986. Ecology completed a Phase I Site Investigation in 1987.

8. Groundwater monitoring began at the Site in 1988. Since then, the network of wells has been systematically expanded. The County has drilled and sampled twenty-five (25) monitoring wells and two (2) extraction wells at the Site. The current well network includes twenty-one (21) on- and off-site wells.

9. The Roza aquifer is one of several aquifers underlying the Site. In January 1990, the "Ephrata Landfill Geohydrologic Assessment Report" described the results of the earliest groundwater sampling at the site. This report predates the Water Quality Standards for Ground Waters of the State of Washington, Ch. 173-200 WAC and the regulations implementing the

state Model Toxics Control Act found in Ch. 173-340 WAC. The report states that the levels of total organic halogens found in the Roza aquifer at MW-3 were "significantly higher" than those found at the other Roza aquifer wells. Additionally, the report noted the detection in MW-3 at "relatively high concentrations" of, for example, 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, vinyl chloride and other breakdown products, benzene, toluene, xylenes, and the pesticide, 1,2-dichloropropane.

10. Data reported in the 2004 annual report on groundwater monitoring activities at the Ephrata Landfill were compared to the groundwater quality criteria found in Ch. 173-200 WAC and the Method B criteria found in Ch. 173-340 as required by the Assessment Monitoring Plan for the old part of the landfill. In that report, the Roza aquifer is described as "characterized by high concentrations of inorganic constituents and corresponding high total dissolved solids." The report states that consistently high concentrations of organic contaminants were found in the Roza aquifer, and that these concentrations were increasing. According to the report, the Interflow aquifer was less contaminated, with a few organic constituents exceeding criteria and several inorganic and metal concentrations exceeding relevant criteria. The report stated that the Outwash aquifer contained moderate total dissolved solids and nitrate concentrations, arsenic concentrations that exceeded criteria but were likely naturally-occurring, fairly constant low-level concentrations of 1,1-dichloroethane and tetrachloroethene that exceeded groundwater criteria, and a detectable concentration of trichlorofluormethane.

11. Of the aquifers that underlie the Site, the three that are closest to the ground surface all contained contaminants at levels exceeding groundwater standards in 2004. The total distance between contaminated wells at the Site is approximately 4,000 feet in a north-south direction and 2200 feet in an east-west direction. However, the landfill is likely not the only source of contamination to the area, and contamination may extend beyond these wells.

## VI. ECOLOGY DETERMINATIONS

1. Grant County is an "owner or operator" as defined in RCW 70.105D.020(12), of a "facility" as defined in RCW 70.105D.020(4) because it currently owns the property and owns and operates the Ephrata Landfill.

2. The City of Ephrata is an "owner or operator" as defined in RCW 70.105D.020(12), of a "facility" as defined in RCW 70.105D.020(4) because it operated the landfill until 1974 and owned the property where the original landfill is located from January 20, 1942 until January 4, 1994.

3. Based upon all factors known to Ecology, a "release" or "threatened release" of "hazardous substance(s)" as defined in RCW 70.105D.020(20) and RCW 70.105D.020(7), respectively, has occurred at the Site.

4. Based upon credible evidence, Ecology issued potentially liable person status letters to Grant County and the City of Ephrata dated October 20, 2000, pursuant to RCW 70.105D.040, -.020(16) and WAC 173-340-500. By letter dated November 28, 2000, Grant County voluntarily waived its rights to notice and comment and accepted Ecology's determination that Grant County is a potentially liable person (PLP) under RCW 70.105D.040. By letter dated December 6, 2000, the City of Ephrata voluntarily waived its rights to notice and comment and accepted Ecology's determination that the City of Ephrata is a potentially liable person under RCW 70.105D.040. Ecology issued Final Determinations of Potentially Liable Person Status to the City of Ephrata and Grant County on January 10, 2005.

5. Pursuant to RCW 70.105D.030(1) and -.050(1), Ecology may require PLPs to investigate or conduct other remedial actions with respect to any release or threatened release of hazardous substances, whenever it believes such action to be in the public interest. Based on the foregoing facts, Ecology believes the remedial actions required by this Order are in the public interest.

6. Under WAC 173-340-430, an interim action is a remedial action that is technically necessary to reduce a threat to human health or the environment by eliminating or substantially reducing one or more pathways for exposure to a hazardous substance, that corrects a problem that may become substantially worse or cost substantially more to address if the remedial action is delayed, or that is needed to provide for completion of a site hazard assessment, remedial investigation/feasibility study or design of a cleanup action.

7. The approximately 2,000 drums of industrial waste buried in the northern portion of the landfill constitute an ongoing threat to human health and the environment. Some of the contaminants detected in the groundwater at the Site are the same chemicals that are believed to be in the drums. Moreover, the drums may have deteriorated over time and released chemicals into the soil and groundwater. In addition, the County is in the process of closing and capping the portion of the landfill in which the drums are located. Once the County has capped the area, it will cost substantially more to remove the drums. These circumstances warrant removal of the drums as an interim action consistent with WAC 173-340-430.

8. The Hole has been identified as a likely source of contamination of the Roza aquifer due to the presence of refuse below the water table. The groundwater found in the bottom 5 to 7 feet of the hole is contaminated. The existing extraction well provides a means to remove the groundwater from the refuse in the Hole and maintain a gradient toward the well. These circumstances warrant extraction and disposal of the water in the Hole.

9. The presumptive remedy at a municipal landfill includes closure capping, landfill gas controls and surface water controls. Constructing a cap will decrease the infiltration of water into the landfill and also decrease the amount of water moving from the refuse into the surrounding soils and groundwater. The cap will also prevent direct human and animal contact with refuse and thus with the contaminants at the site. The gas controls prevent offsite gas migration and decrease the diffusion of contaminants into groundwater. Surface water controls prevent the flow of water from offsite onto the landfill and minimize the erosion potential. Construction of these presumptive remedies will decrease the risk or potential risk of the release of hazardous substances from the landfill and is warranted. As presumptive remedies, these measures should be implemented as soon as practicable.

## VII. WORK TO BE PERFORMED

Based on the Findings of Fact and Ecology Determinations, it is hereby ordered that PLPs take the following remedial actions at the Site and that these actions be conducted in accordance with Chapter 173-340 WAC unless otherwise specifically provided for herein.

## A. Remedial Investigation/Feasibility Study (RI/FS)

### 1. Remedial Investigation Work Plan

a. An RI/FS Work Plan is attached as Exhibit B and is incorporated herein by this reference.

b. The PLPs shall perform the tasks described in the Work Plan in accordance with the Schedule, attached as Exhibit D. Exhibit D is subject to revision as described in Section VIII.K (Extension of Schedule).

### 2. Remedial Investigation and Feasibility Report

a. PLPs shall submit a draft remedial investigation and feasibility study (RI/FS) (Ecology Review Draft RI/FS) to Ecology in accordance with WAC 173-340-350 for Ecology review and comment by the date shown on the Project Schedule, Exhibit D. Ecology will provide written comments on the draft RI/FS within 30 days of receipt of the draft.

b. Within forty-five (45) days of receiving Ecology's comments on the Ecology Review Draft RI/FS, PLPs shall submit a revised RI/FS to Ecology addressing Ecology's comments on the Ecology Review Draft RI/FS. If Ecology comments require additional sampling, a Revised Draft RI/FS will be submitted to Ecology within forty-five (45) days of receipt of the analytical results on the additional samples. If either or both PLPs disagree(s) with Ecology's comments, it may trigger the Dispute Resolution process described in Section VIII J.

c. After Ecology has determined the Revised Draft RI/FS has adequately addressed Ecology's comments, Ecology will make the draft available to the public consistent with WAC 173-340-600(13)(c). Following completion of the review period, Ecology will, in cooperation with the PLPs, prepare a responsiveness summary if any public comments are received.

d. Within forty-five (45) days of receipt of Ecology's responsiveness summary, the PLPs shall submit a revised RI/FS addressing issues raised during public comment. Once Ecology determines that public comments have been adequately addressed, Ecology will declare the RI/FS final (the "Final RI/FS").

### 3. Progress Reports

During performance of RI/FS pursuant to this Order, the PLPs will submit written progress reports to Ecology. The progress reports will summarize work performed during the reporting period, and the work anticipated during the following quarter. Progress reports shall be submitted to the Ecology project coordinator by the 10th day of every second month following the effective date of the Agreed Order.

### 4. Performance

If, at any time after the first exchange of comments on drafts, Ecology determines that insufficient progress is being made in the preparation of any of the deliverables required by this section, Ecology may complete and issue the final deliverable.

## B. Interim Actions

1. An Interim Remedial Action Work Plan (IRAP) is attached as Exhibit C and is incorporated herein by this reference.

2. Under the direct supervision of a registered professional engineer, licensed professional hydrogeologist, or other qualified professional, the PLPs will commence the first interim remedial action within 60 days of the date of the Agreed Order.

3. All Interim Action sampling and analysis shall be conducted pursuant to the Sampling and Analysis Plan incorporated into the IRAP. The PLPs shall perform the Interim Actions in accordance with the Health and Safety Plan incorporated into the IRAP. The PLPs will conduct compliance monitoring in accordance with the IRAP and WAC 173-340-410.

4. During performance of the Interim Action, the PLPs shall maintain detailed records including photographic documentation of substantive aspects of the work performed, including construction techniques and materials used, items installed, and tests and measurements performed. During the drum removal portion of the interim actions only, the PLPs' project coordinators or designees shall provide progress reports to Ecology's project coordinator on a weekly basis. Each progress report shall identify accomplishments for the prior week and expected accomplishments for the upcoming weeks. At all other times during the interim actions. PLPs will submit written monthly progress reports to Ecology unless an alternate

schedule is requested by the PLPs and agreed to by Ecology in writing. The progress reports will summarize work performed during the month, and the work anticipated during the following month. Progress reports shall be submitted to the Ecology project coordinator by the 10th day of every month during which Interim Actions are underway.

## VIII. TERMS AND CONDITIONS OF ORDER

### A. Public Notices

RCW 70.105D.030(2)(a) requires that, at a minimum, this Order be subject to concurrent public notice. Ecology shall be responsible for providing such public notice and reserves the right to modify or withdraw any provisions of this Order should public comment disclose facts or considerations which indicate to Ecology that the Order is inadequate or improper in any respect. If Ecology makes changes in the Order with which a PLP disagrees, the PLP may withdraw from the Order.

### B. Remedial Action Costs

PLPs shall pay to Ecology costs incurred by Ecology pursuant to this Order and consistent with WAC 173-340-550(2). These costs shall include work performed by Ecology or its contractors for, or on, the Site under Chapter 70.105D RCW, including remedial actions and Order preparation, negotiation, oversight, and administration. These costs shall include work performed both prior to and subsequent to the issuance of the Order. PLPs shall pay the required amount within ninety (90) days of receiving from Ecology an itemized statement of costs that includes a summary of costs incurred, an identification of involved staff, and the amount of time spent by involved staff members on the project as well as Site Logs for each staff member billing time to this project. Itemized statements shall be prepared quarterly. Pursuant to WAC 173-340-550(4), failure to pay Ecology's costs within ninety (90) days of receipt of the itemized statement of costs will result in the application of interest charges at the rate of twelve percent (12%) per annum, compounded monthly. If, however, a PLP disputes costs included in an

Ecology itemized statement of costs incurred, the dispute resolution procedures described in Section VIII.L. below must be triggered within fourteen (14) days of receipt of the statement.

**C. Implementation of Remedial Action**

Except where necessary to abate an emergency situation, PLPs shall not perform any remedial actions at the Site outside those remedial actions required by this Order, unless Ecology concurs, in writing, with such additional remedial actions.

**D. Designated Project Coordinators**

The project coordinator for Ecology is:

Cole H. Carter
Solid Waste and Financial Assistance Program
Eastern Regional Office, Washington State Dep't of Ecology
4601 N. Monroe
Spokane, WA 99205
(509) 329-3609

The project coordinator for Grant County is:

Derek Pohle, P.E.
Public Works Director/County Engineer
124 Enterprise Street S.E.
Ephrata, WA 98823
(509) 754-6084

The project coordinator for the City of Ephrata is:

Wes Crago
City Administrator
121 Adler Street S.W.
Ephrata, WA 98823
(509) 754-4601

The project coordinators shall be responsible for overseeing the implementation of this Order. The Ecology project coordinator will be Ecology's designated representative for the Site. To the maximum extent possible, communications between Ecology and PLPs, and all documents, including reports, approvals, and other correspondence concerning the activities performed pursuant to the terms and conditions of this Order shall be directed through the project coordinator(s).

Ecology and PLPs may change their respective project coordinators, but must provide ten (10) days advance written notification of the change to the other parties.

## E. Performance

All work performed pursuant to this Order shall be under the direction and supervision, as necessary, of a licensed professional engineer or licensed hydrogeologist, or equivalent as approved by Ecology, with experience and expertise in hazardous waste site investigation and cleanup. PLPs shall notify Ecology in writing of the identity of such engineer(s), or hydrogeologist(s), or others, and of any contractors and subcontractors to be used in carrying out the terms of this Order, in advance of their involvement at the Site.

Any construction work performed pursuant to the Order shall be under the supervision of a professional engineer or a qualified technician under the direct supervision of a professional engineer. The professional engineer must be registered in the State of Washington, except as provided in RCW 18.43.130. For well construction, supervision by a licensed geologist is appropriate and allowed.

## F. Access

Ecology or any Ecology-authorized representative shall have the full authority to enter and freely move about all property at the Site that PLPs either own, control, or have access rights to at all reasonable times for the purposes of, *inter alia*: inspecting records, operation logs, and contracts related to the work being performed pursuant to this Order; reviewing PLPs' progress in carrying out the terms of this Order; conducting such tests or collecting such samples as Ecology may deem necessary; using a camera, sound recording, or other documentary type equipment to record work done pursuant to this Order; and verifying the data submitted to Ecology by PLPs. Each of the PLPs shall keep all records related to its compliance with this Order in a specified location; shall notify Ecology of that location; and shall provide Ecology access to those records upon request. PLPs shall make all reasonable efforts to secure access rights for those properties within the Site not owned or controlled by PLPs where remedial activities or investigations will be performed pursuant to this Order. Ecology or any Ecology-authorized representative shall give reasonable notice before entering any Site property owned or controlled by PLPs unless an emergency prevents such notice. All persons who access the Site pursuant to this paragraph shall comply with the approved health and safety plan, if any.

Ecology employees and their representative shall not be required to sign any release or waiver as a condition of site property access.

**G. Sampling, Data Submittal, and Availability**

With respect to the implementation of this Order, PLPs shall make the results of all sampling, laboratory reports, and/or test results generated by it or on its behalf available to Ecology. Pursuant to WAC 173-340-840(5), all sampling data shall be submitted to Ecology in both printed and electronic formats in accordance with Section VII (Work to be Performed), and Ecology's Toxics Cleanup Program Policy 840 (Data Submittal Requirements). If requested by Ecology, PLPs shall allow split or duplicate samples to be taken by Ecology and/or its authorized representative of any samples collected by PLPs pursuant to implementation of this Order. PLPs shall notify Ecology seven (7) days in advance of any sample collection or work activity at the Site. Ecology shall, upon request, allow split or duplicate samples of any samples collected by Ecology pursuant to the implementation of this Order to be taken by PLPs or their authorized representatives provided it does not interfere with Ecology's sampling. Without limitation on Ecology's rights under Section VIII.F. of this Order, Ecology shall notify PLPs seven (7) days prior to any sample collection activity that will occur at a time when the PLPs' groundwater consultants are not scheduled to be on-site unless an emergency prevents such notice.

In accordance with WAC 173-340-830(2)(a), all hazardous substance analyses shall be conducted by a laboratory accredited under Chapter 173-50 WAC for the specific analyses to be conducted, unless otherwise approved by Ecology.

**H. Public Participation**

A public participation plan is required for this Site. Ecology shall maintain the lead responsibility for public participation at the Site. However, Ecology shall work cooperatively with PLPs to develop a public participation plan for activities at the Site. The public participation plan shall authorize Ecology to delegate to PLPs all or portions of these tasks:

1. Provide information to the public, public notice, and opportunities to comment as specified in WAC 173-340-600 for upcoming activities at the Site;

2. Prepare drafts of press releases, public notices, and fact sheets at important stages of the remedial investigation, feasibility study, and interim actions at the Site;

3. Coordinate press, public notice, and fact sheet releases before major meetings and presentations with the interested public and local government;

4. Arrange for and/or continue information repositories to be located at the following locations:

a. Ephrata City Library
45 Alder Street N.W.
Ephrata, WA 98823

b. Ecology's Eastern Regional Office
4601 N. Monroe Street
Spokane, WA 99105

At a minimum, copies of all public notices, fact sheets, and press releases; all quality assured monitoring data; remedial action plans and reports, supplemental remedial planning documents, and all other similar documents relating to performance of the remedial actions required by this Order shall be promptly placed in these repositories.

PLPs and Ecology shall work cooperatively to implement public participation activities for the Site. This shall include the issuance of press releases, distribution of fact sheets, and participation in public meetings and presentations on the progress of the remedial actions at the Site. Participation may be through attendance at public meetings to assist in answering questions or as a presenter.

In the event of a disagreement over the contents of any document or action prepared for purposes of public participation, issues shall be resolved in a mutually agreeable manner. Disagreements between PLPs' and Ecology's project managers shall be elevated to their respective section heads or directors for resolution if they cannot be resolved by the project managers.

## I. Retention of Records

During the pendency of this Order and for ten (10) years past the period required under WAC 173-351-500 for post-closure care, as areas of the landfill are closed, PLPs shall preserve

all records, reports, documents, and underlying data in its possession relevant to the implementation of this Order and shall insert a similar record retention requirement into all contracts with project contractors and subcontractors. Upon request of Ecology, PLPs shall make all records available to Ecology and allow access for review within a reasonable time.

**J. Resolution of Disputes**

1. In the event a dispute arises as to an approval, disapproval, proposed change, or other decision or action by Ecology's project coordinator, or an itemized billing statement under Section VIII.B (Remedial Action Costs), the Parties shall utilize the dispute resolution procedure set forth below.

a. Upon receipt of the Ecology project coordinator's decision or the itemized billing statement, PLP has fourteen (14) days within which to notify Ecology's project coordinator of its objection to the decision or itemized statement.

b. The Parties' project coordinators shall then confer in an effort to resolve the dispute. If the project coordinators cannot resolve the dispute within fourteen (14) days, Ecology's project coordinator shall issue a written decision.

c. The PLP may then request Ecology management review of the decision. This request shall be submitted in writing to the Eastern Region Solid Waste Section Manager within seven (7) days of receipt of Ecology's project coordinator's decision.

d. The Section Manager shall conduct a review of the dispute and shall endeavor to issue a written decision regarding the dispute within sixty (60) days of PLP’s request for review. The Section Manager's decision shall be Ecology's final decision on the disputed matter.

2. The Parties agree to only utilize the dispute resolution process in good faith and agree to expedite, to the extent possible, the dispute resolution process whenever it is used.

3. Implementation of these dispute resolution procedures shall not provide a basis for delay of any activities required in this Order, unless Ecology agrees in writing to a schedule extension.

## K. Extension of Schedule

1. An extension of schedule shall be granted only when a request for an extension is submitted in a timely fashion, generally at least thirty (30) days prior to expiration of the deadline for which the extension is requested, and good cause exists for granting the extension. All extensions shall be requested in writing. The request shall specify the reason(s) the extension is needed. The request shall specify:

a. The deadline that is sought to be extended;

b. The length of the extension sought;

c. The reason(s) for the extension; and

d. Any related deadline or schedule that would be affected if the extension were granted.

2. The burden shall be on PLPs to demonstrate to the satisfaction of Ecology that the request for such extension has been submitted in a timely fashion and that good cause exists for granting the extension. Good cause includes, but is not limited to:

a. Circumstances beyond the reasonable control and despite the due diligence of PLPs, including delays caused by unrelated third parties or Ecology, such as (but not limited to) delays by Ecology in reviewing, approving, or modifying documents submitted by PLPs; or

b. Acts of God, including fire, flood, blizzard, extreme temperatures, storm, or other unavoidable casualty; or

c. Endangerment as described in Section VIII.M. of this Order.

Generally, neither increased costs of performance of the terms of an Agreed Order nor changed economic circumstances shall be considered circumstances beyond the reasonable control of the PLPs. However, because the PLPs in this circumstance are small municipalities that are: (1) subject to unpredictable revenue streams; (2) responsible for addressing unknown emergencies, disasters and threats to public health in their communities that may require significant financial resources; and (3) subject to legal and procedural budgetary constraints that may limit, or delay, the availability of financial resources, in some circumstances increased costs

of performance or changed economic circumstances may present good cause for an extension. Ecology retains discretion to weigh such factors in granting or denying any extension.

3. Ecology shall act upon any written request for extension in a timely fashion. Ecology shall give PLPs written notification in a timely fashion of any extensions granted pursuant to the Order. A requested extension shall not be effective until approved by Ecology. Unless the extension is a substantial change, it shall not be necessary to amend this Order pursuant to Section VIII.L. when a schedule extension is granted.

4. An extension shall only be granted for such period of time as Ecology determines is reasonable under the circumstances. Ecology may grant schedule extensions exceeding ninety (90) days only as a result of:

a. Delays in the issuance of a necessary permit which was applied for in a timely manner;

b. Other circumstances deemed exceptional or extraordinary by Ecology; or

c. Endangerment as described in Section VIII.M. of this Order.

**L. Amendment of Order**

1. The project coordinators may orally agree to minor changes to the work to be performed without formally amending this Order. Minor changes will be documented in writing by Ecology within seven (7) days of verbal agreement.

2. Except as provided in Section VIII.N. of this Order, substantial changes to the work to be performed under this Order, including substantial changes to the Work Plan, shall require formal amendment of this Order. This Order may only be formally amended by the written consent of both Ecology and PLPs.

a. PLPs shall submit a written request for amendment to Ecology for approval. Ecology shall indicate its approval or disapproval in writing and in a timely manner after the written request for amendment is received. If the amendment to the Order represents a substantial change, Ecology will provide additional public notice and opportunity to comment. If Ecology does not agree to a proposed amendment, the disagreement may be addressed through the dispute resolution procedures described in Section VIII.J. of this Order.

b. Should Ecology wish to amend this Order, Ecology will notify the PLPs. If the requested amendment represents a substantial change, the Parties will provide additional public notice and opportunity to comment. If a PLP disagrees with the proposed amendment, it can request a meeting with Ecology or invoke the dispute resolution process described in Section VIII.J. of this Order.

**M. Endangerment**

In the event Ecology determines that any activity being performed at the Site is creating or has the potential to create a danger to human health or the environment on or surrounding the Site, Ecology may direct PLPs to cease such activities for such period of time as it deems necessary to abate the danger. PLPs shall immediately comply with such direction.

If, for any reason, PLPs determine that any activity being performed at the Site is creating or has the potential to create a danger to human health or the environment, PLPs may cease such activities. PLPs shall notify Ecology's project coordinator as soon as possible, but no later than twenty-four (24) hours after making such determination or ceasing such activities. Upon Ecology's direction, PLPs shall provide Ecology with documentation of the basis for the determination or cessation of such activities. If Ecology disagrees with PLPs' cessation of activities, it may direct PLPs to resume such activities.

If Ecology concurs with or orders a work stoppage pursuant to this section, PLPs' obligations with respect to the ceased activities shall be suspended until Ecology determines the danger is abated, and the time for performance of such activities, as well as the time for any other work dependent upon such activities, shall be extended for such period of time as Ecology determines is reasonable under the circumstances.

Either PLP may utilize the Dispute Resolution Provisions of Section VIII.J. of this Order if it disagrees with Ecology's determinations regarding the existence of conditions necessitating work stoppage or the refusal to extend any affected deadlines. If, however, Ecology requires a work stoppage, the PLPs agrees to stop work during the dispute resolution process, and Ecology agrees to move expeditiously through the dispute resolution process.

Nothing in this Order shall limit the authority of Ecology, its employees, agents, or contractors to take or require appropriate action in the event of an emergency.

**N. Reservation of Rights/No Settlement**

This Order is not a settlement under Chapter 70.105D RCW. Ecology's signature on this Order in no way constitutes a covenant not to sue or a compromise of any Ecology rights or authority. Ecology will not, however, bring an action against PLPs to recover remedial action costs paid to and received by Ecology under this Order. In addition, Ecology will not take additional enforcement actions against PLPs regarding remedial actions required by this Order, provided PLPs comply with this Order.

Ecology nevertheless reserves its rights under Chapter 70.105D RCW, including the right to require additional or different remedial actions at the Site should it deem such actions necessary to protect human health and the environment, and to issue orders requiring such remedial actions. Ecology also reserves all rights regarding the injury to, destruction of, or loss of natural resources resulting from the release or threatened release of hazardous substances at the Site.

**O. Transfer of Interest in Property**

No voluntary conveyance or relinquishment of title, easement, leasehold, or other interest in any portion of the Site shall be consummated by PLPs without provision for continued implementation of all requirements of this Order and implementation of any remedial actions found to be necessary as a result of this Order.

Prior to a PLP's transfer of any interest in all or any portion of the Site, and during the effective period of this Order, PLP shall provide a copy of this Order upon any prospective purchaser, lessee, transferee, assignee, or other successor in said interest; and, at least thirty (30) days prior to any transfer, PLP shall notify Ecology of said transfer. Upon transfer of any interest, PLP shall restrict uses and activities to those consistent with this Order and notify all transferees of the restrictions on the use of the property.

## P. Compliance with Applicable Laws

1. All actions carried out by PLPs pursuant to this Order shall be done in accordance with all applicable federal, state, and local requirements, including requirements to obtain necessary permits, except as provided in RCW 70.105D.090. A list of the required permits known at the time of entry of this Order has been included in Exhibit E.

2. Pursuant to RCW 70.105D.090(1), PLPs are exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48 and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals. However, PLPs shall comply with the substantive requirements of such permits or approvals. A list of such permits and approvals and/or the substantive requirements of those permits and approvals as they are known to be applicable at the time of entry of this Order, have been included in Exhibit E.

PLPs have a continuing obligation to determine whether additional permits or approvals addressed in RCW 70.105D.090(1) would otherwise be required for the remedial action under this Order. In the event either Ecology or a PLP determines that additional permits or approvals addressed in RCW 70.105D.090(1) would otherwise be required for the remedial action under this Order, it shall promptly notify the other parties of its determination. Ecology shall determine whether Ecology or PLPs shall be responsible to contact the appropriate state and/or local agencies. If Ecology so requires, PLPs shall promptly consult with the appropriate state and/or local agencies and provide Ecology with written documentation from those agencies of the substantive requirements those agencies believe are applicable to the remedial action. Ecology shall make the final determination on the additional substantive requirements that must be met by PLPs and on how PLPs must meet those requirements. Ecology shall inform PLPs in writing of these requirements. Once established by Ecology, the additional requirements shall be enforceable requirements of this Order. PLPs shall not begin or continue the remedial action potentially subject to the additional requirements until Ecology makes its final determination.

Ecology shall ensure that notice and opportunity for comment is provided to the public and appropriate agencies prior to establishing the substantive requirements under this section.

3. Pursuant to RCW 70.105D.090(2), in the event Ecology determines that the exemption from complying with the procedural requirements of the laws referenced in RCW 70.105D.090(1) would result in the loss of approval from a federal agency which is necessary for the state to administer any federal law, the exemption shall not apply and PLPs shall comply with both the procedural and substantive requirements of the laws referenced in RCW 70.105D.090(1), including any requirements to obtain permits.

**Q. Indemnification**

PLPs agree to indemnify and save and hold the State of Washington, its employees, and agents harmless from any and all claims or causes of action for death or injuries to persons or for loss or damage to property arising from or on account of acts or omissions of PLPs, their officers, employees, agents, or contractors in entering into and implementing this Order. However, the PLPs shall not indemnify the State of Washington nor save nor hold its employees and agents harmless from any claims or causes of action arising out of the negligent acts or omissions of the State of Washington, or the employees or agents of the State, in implementing the activities pursuant to this Order.

The State of Washington agrees to indemnify and save and hold PLPs, their officials, officers, employees and contractors harmless to the extent allowed by law.

## IX. SATISFACTION OF ORDER

The provisions of this Order shall be deemed satisfied upon PLPs' receipt of written notification from Ecology that they have completed the remedial actions required by this Order, as amended by any modifications, and that the PLPs have complied with all other provisions of this Agreed Order.

## X. ENFORCEMENT

This Order may be enforced pursuant to RCW 70.105D.050.

This Order is not appealable to the Washington Pollution Control Hearings Board. This Order may be reviewed only as provided under RCW 70.105D.060.

Effective date of this Order: _____

**GRANT COUNTY**

Richard Stevens
Commissioner

K.C. Allen
Commissioner

Deborah Kay Moore 12/11/06
Commissioner

**CITY OF EPHRATA**

Mayor

City Administrator

**STATE OF WASHINGTON**
**DEPARTMENT OF ECOLOGY**

Michael A. Hibbler
Section Manager
Solid Waste and Financial Assistance Program
Eastern Regional Office
(509) 329-3466

**GRANT COUNTY**

Commissioner

Commissioner

Commissioner

**CITY OF EPHRATA**

Mayor

City Administrator

**STATE OF WASHINGTON**
**DEPARTMENT OF ECOLOGY**

Michael A. Hibbler
Section Manager
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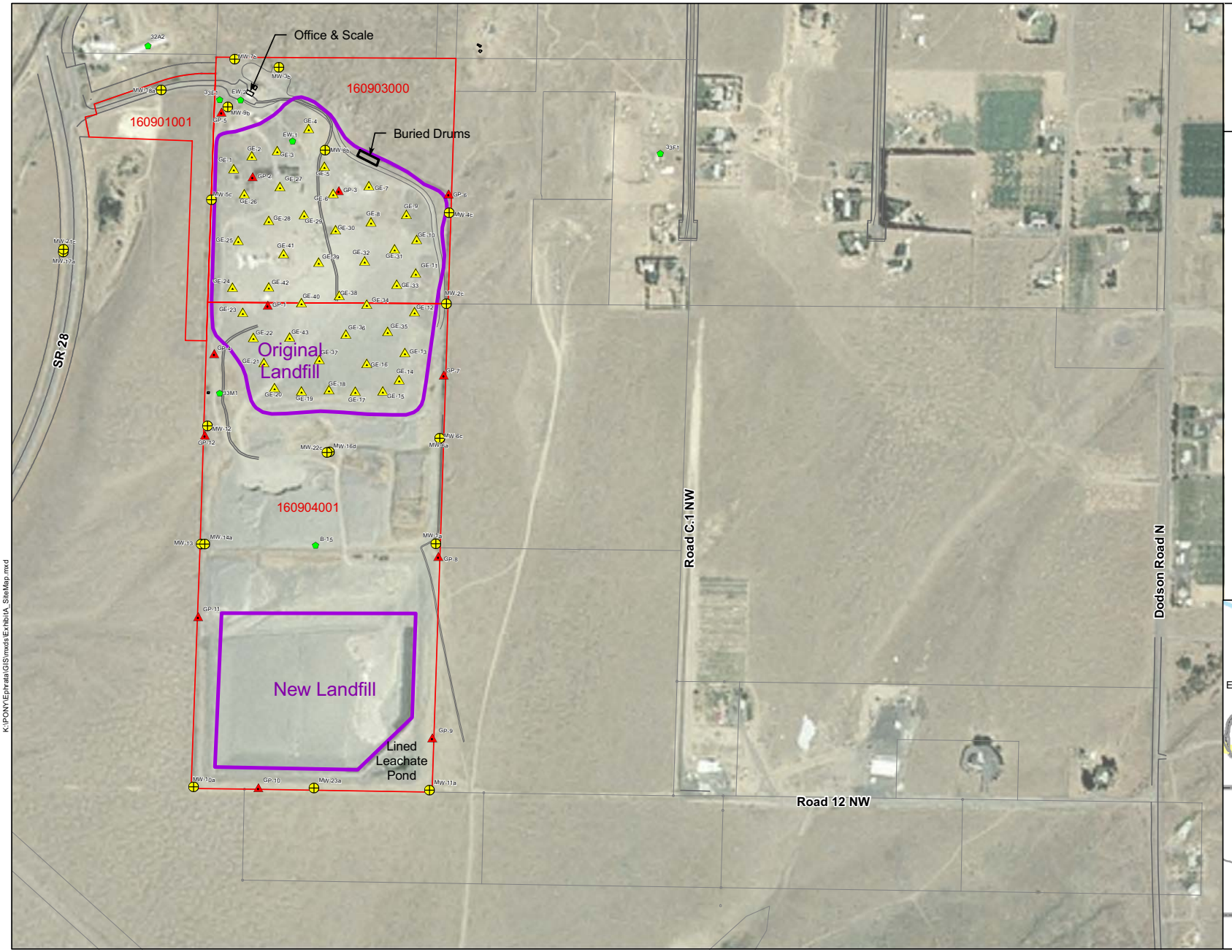



# Exhibit A
# Ephrata Landfill

Ephrata Landfill

PgG

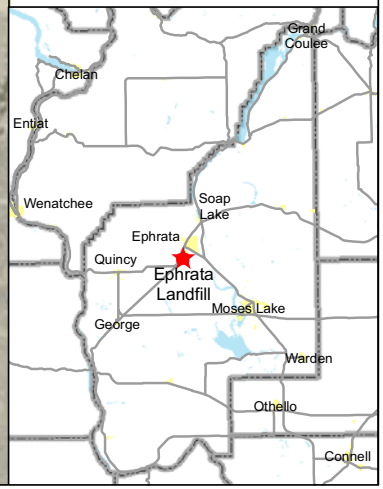
County Owned Parcels
160901001: Parcel Number
Landfill Extents

Well Type
- Monitoring Well (MW)
- Gas Extraction (GE)
- Gas Probe (GP)
- Other Well

2004 NAIP Orthophoto

N

0 Feet 500




K:\PONY\Ephrata\GIS\mxds\Exhibit\A_SiteMap.mxd

Exhibit A

LEGAL DESCRIPTION of EPHRATA LANDFILL

Parcel 160903000 – THE SOUTHWEST QUARTER OF THE NORTHWEST QUARTER, SECTION 33, TOWNSHIP 21 N., RANGE 26 E., WILLAMETTE MERIDIAN, GRANT COUNTY, WASHINGTON.

Parcel 160904001 – THE WEST HALF OF THE SOUTHWEST QUARTER OF SECTION 33, TOWNSHIP 21 N., RANGE 26 E., WILLAMETTE MERIDIAN, GRANT COUNTY, WASHINGTON.

Parcel 160901001 -THE EAST 120.00 FEET OF THE SOUTH 900.00 FEET OF THE SOUTH-EAST QUARTER OF THE NORTHEAST QUARTER AND THE EAST 120.00 FEET OF THE NORTH 200.00 FEET OF THE NORTHEAST QUARTER OF THE SOUTHEAST QUARTER, SECTION 32, TOWNSHIP 21 N., RANGE 26 E., WILLAMETTE MERIDIAN, GRANT COUNTY, WASHINGTON, LYING EAST OF THE RIGHT-OF-WAY OF SR28 AND ALL THAT PORTION OF THE SOUTHEAST QUARTER OF THE NORTHEAST QUARTER LYING EAST OF THE RIGHT-OF-WAY FOR SR28 AND SOUTH OF THE FOLLOWING DESCRIBED LINE; BEGINNING AT THE NORTHEAST CORNER OF THE SOUTHEAST QUARTER OF THE NORTHEAST QUARTER; THENCE SOUTH 00°08'50" WEST A DISTANCE OF 90.00 FEET ALONG THE EAST LINE OF SECTION 32 TO THE TRUE POINT OF BEGINNING; THENCE SOUTH 88°19'40" WEST DISTANCE OF 77.54 FEET; THENCE ON A 716.20 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 19°05'42", AND AN ARC LENGTH OF 238.69 FEET, THE LONG CHORD FOR WHICH BEARS SOUTH 77°04'34" WEST A DISTANCE OF 237.59 FEET; THENCE SOUTH 69°13'56" WEST A DISTANCE OF 388.63 FEET TO THE EASTERLY RIGHT-OF-WAY OF SR 28 AND THERE TERMINATING, EXCEPTING THERE FROM THE SOUTH 900.00 FEET.

# Final Remedial Investigation/Feasibility Study (RI/FS) Work Plan

# Ephrata Landfill Corrective Action

*Prepared for*

**Grant County Department of Public Works**

and

**City of Ephrata**

*Prepared by*

**Pacific Groundwater Group**
2377 Eastlake Avenue East
Seattle, Washington 98102
206-329-0141
www.pgwg.com

*In Association with:*
**Parametrix**
411 108th Avenue NE, Suite 1800
Bellevue, WA 98004-5571
425-458-6200
www.parametrix.com

**September 29, 2006**

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## LIST OF FIGURES

# 1 INTRODUCTION

This document summarizes work to be performed during a groundwater Remedial Investigation and Feasibility Study (RI/FS) at the Ephrata Landfill (Site) in Grant County, Washington. The RI/FS work plan is in addition to work that will be performed under the Interim Remedial Action Plan (IRAP), which is summarized in this work plan, and submitted at this time under separate cover. Work will be performed by Parametrix, Inc. and Pacific Groundwater Group under a Professional Services Agreement with Grant County (County) and the City of Ephrata (City) (the Potentially Liable Parties or PLPs) or their legal representatives. The RI/FS will be conducted to select remedial measures to address contamination at the Site and to select a final remedy for cleanup in compliance with the requirements of the Model Toxics Control Act, Chapter 70.105D RCW, and its implementing regulations, Chapter 173-340 WAC.

# 2 SITE LOCATION, OWNERSHIP, AND OPERATION

The Site is located about three miles south of the City of Ephrata on the east side of Highway 28 in the western portion of Section 33, Township 21 North, Range 26 East, Willamette Meridian (**Figure 1**). The City of Ephrata began operating the landfill in approximately 1942 and owned and operated it until 1974. The City owned part of the property set aside for the landfill and leased additional property from the United States Bureau of Reclamation. In 1974, the City and the County entered into the first of a series of agreements under which the County leased the landfill and operated the facility. In 1990, the Bureau of Reclamation transferred its landfill property to the County. In 1994, the City deeded its landfill property to the County. A new landfill on the site remains the primary solid waste disposal facility for Grant County.

Filling began in the northwest portion of the original landfill and expanded south and east as an unlined landfill until a new lined landfill was opened in 2004 (**Figure 1**). Burning was allowable in the early open dump, but practices were not documented. Unintentional fires have occurred more recently in the original landfill. The new landfill is physically separated from and located to the south of the old landfill. The old landfill was permitted by Grant County Health District first under Chapter 173-304 Washington Administrative Code (WAC) and then under Chapter 173-351 WAC. The new landfill is permitted under Chapter 173-351 WAC. Current solid-waste-related facilities at the site consist of the old landfill, which is no longer receiving waste and which is being prepared for closure, the new lined landfill, recycling facilities, leachate evaporation pond, a machine shop and office, a truck scale, electric power, a deep water supply well, two lysimeters, and numerous landfill gas and groundwater monitoring wells. The County has recently acquired additional land parcels and is planning changes to site access for the new landfill (**Figure 1**).

# 3 OBJECTIVES OF THE RI/FS

The County and City (Potentially Liable Parties - PLPs) are performing this RI/FS to evaluate site cleanup requirements under applicable regulations. The RI/FS will comply with cleanup requirements administered by the Department of Ecology (Ecology) under Model Toxics Control Act, Chapter 173-340 WAC regulations. MTCA is used by the State to enforce and guide cleanup of solid waste facilities undergoing corrective action as defined in Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC). The RI/FS will be used to define the remedial measures required to clean up the site under these regulations.

The RI/FS is being performed under an Agreed Order with Ecology. Upon completion of the RI/FS, the PLPs will evaluate the administrative options for implementing any necessary remedial actions.

This document provides an overview of tasks to investigate the site and evaluate remedial options. Investigation tasks are described in Sections 5 and 6 and remedial option evaluations are described in Section 7. These general task descriptions will be supplemented by a Sampling and Analysis Plan, Quality Assurance Plan, and Health and Safety Plan, to be provided prior to field work.

# 4 BASIS AND RATIONALE FOR RI/FS SCOPE

This section provides an overview of previous investigative findings at the Site, an evaluation of MTCA clean up requirements, and the rationale on which the scope of work for the RI/FS is based.

## 4.1 PREVIOUS FINDINGS

The following sections provide an overview of past environmental investigative work conducted at the site, a summary of the site conceptual model, and site hydrogeology.

### *4.1.1 Overview of Prior Environmental Investigations and Events*

The following list summarizes the modern environmental events and investigations at the site.

1937: Land Classification Map by U.S. Bureau of Reclamation defines pre-waste soil conditions and topography.
1942: Landfilling begins.

1950's: 30 ft increase in water table elevation in response to importation of irrigation water by the federal Columbia Basin Irrigation Project. State of Washington publishes Water Supply Bulletin No. 8 (Walters and Grolier, 1960).
1975: Disposal of approximately 2000 drums of industrial waste.
1984: Ecology submitted a Preliminary Assessment to the EPA and recommended a follow-up Site Investigation.
1987: The EPA conducted a preliminary Site Investigation and intended no follow-up investigation.
1987: Ecology completed a Phase I Site Inspection Report stating that further actions should be based on near-future groundwater monitoring to be developed by the County.
1989: Groundwater and landfill gas monitoring began at the Site.
1990: Black and Veatch Inc. and Pacific Groundwater Group publish the first Hydrogeologic Assessment Report which documents anomalous groundwater quality (B&V and PGG, 1990a). Numerous groundwater monitoring reports were submitted to Grant County Health District and Ecology starting at this time.
1990: Black and Veatch Inc. and Pacific Groundwater Group publish a Phase 2 investigation report on the "Roza Aquifer" which delineates and describes contamination in that aquifer (B&V and PGG, 1990b).
1993: Decommissioning and replacement of old water supply well (which was contaminated).
2000: Corrective Action proposed by County in letter to Ecology.
2000 – 2002: Pacific Groundwater Group installs numerous additional monitoring wells and two extraction wells, and performs testing of the Roza aquifer.
2004: The new landfill opens and waste is no longer placed in the old unlined landfill.

### *4.1.2 Summary of Site Conceptual Model*

Based on the investigations cited above, a site conceptual model has been developed and is described in this subsection. Subsequent subsections provide greater detail on the hydrogeologic conditions upon which the conceptual model is based. The existing data are used to focus the efforts of this RI/FS by developing a preliminary site conceptual model; identifying existing data gaps; developing a preliminary list of contaminants of concern (COC); and identifying a preliminary point of compliance (POC).

Waste disposal began in the northwest corner of the northern-most 40-acre parcel and proceeded first toward the east, and then south. Waste was initially deposited within both natural depressions and trenches excavated within the outwash soils above basalt. Burning of waste in areas of early disposal was reportedly allowed to reduce volume prior to covering. Unintentional fires have also occurred and these were sometimes controlled with application of water. Hazardous wastes were typically included in landfill refuse disposed prior to 1981 when Resource Conservation and Recovery Act

requirements changed that practice[1]. In the case of Ephrata landfill, we distinguish possible incidental hazardous waste from the drums of industrial waste known to have been stacked and covered. At this site, the County ceased intentional disposal of industrial waste in 1975.

The water table rose about 30 feet in the early 1950s in response to leakage of water from irrigation works of the Columbia Basin Irrigation Project (Walters and Grolier, 1960). The water table rose to saturate the lowest few feet of refuse over a limited area at the north end of the old landfill.

Some time prior to 1983[2], a basalt aquifer – now called the Roza aquifer – and limited areas of groundwater within saturated outwash became contaminated with inorganic and organic contaminants as a result of leaching of refuse and possible migration of liquid wastes into the aquifer. These contaminated water bodies are not naturally well connected to other aquifers. Nonetheless, contaminants from this aquifer on the north end of the old landfill migrated slowly with groundwater, primarily downward and to the south, with limited migration now documented to the west. One probable route of downward migration was the old water supply well on the west edge of the old landfill (**Figure 2**) which penetrated the Roza aquifer and lower basalt aquifers with an open borehole until May 1986. Some contaminants degraded naturally along the flow paths and all contaminants were diluted by the large volumes of groundwater found in the larger downgradient aquifers – now called the Interflow aquifer and Outwash aquifer (**Figure 3**).

Other contaminant migration pathways to groundwater may be, or may have been, active. Landfill gas is generated by decomposing refuse. The gas contains low concentrations of volatile organic contaminants that evaporate from the refuse. The contaminants can diffuse or advect with the migrating landfill gas (which is largely methane and carbon dioxide). Subsequent diffusion into the underlying groundwater can result in groundwater contamination.

Another potential pathway of contaminant migration is leachate derived directly from newer refuse. Low volumes of seasonal precipitation and possible moisture created from decomposition move downward through the waste. Large volumes of water have been sprayed onto the newer parts of the old landfill to control fires within the refuse. Downward migration of these waters and leaching of constituents within the refuse could result in groundwater contamination within the Interflow and Outwash aquifers. In addition, poplar trees have been fertilized and irrigated near the landfill. Leaching of

[1] Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, EPA/540/P-91/001, OSWER Directive 9355.3-11, February 1991

[2] A groundwater sample from the old supply well was analyzed in 1983. The analyses suggest groundwater contamination existed at that time.

fertilizer constituents could appear to be landfill leachate. The Roza aquifer is not part of these potential contaminant pathways.

A plume of groundwater contamination is slowly expanding to the south with possible smaller components of flow to the east and west within the Interflow and Outwash aquifers. Downward migration to deeper basalt aquifers is also possible, but has been minor to date, except locally at the old supply well, which was pressure grouted and decommissioned in 1993. The mass of contaminants is dominated by common inorganic leachate constituents with lower concentrations of organic contaminants including fuel constituents and chlorinated solvents. Preliminary evidence suggests both physical and chemical/biological attenuation is occurring.

The Roza aquifer does not extend off-site in downgradient directions. The Interflow and Outwash aquifers do extend off-site with the Interflow aquifer used in downgradient areas for domestic water supply. However, development in the area is sparse and the closest well toward the south is more than 2500 feet from the old landfill. The Outwash aquifer (with its artificially high water table) is drained by irrigation wasteways but supports wetlands and other surface water features with possible ecological value. Although the Columbia River lies west of the site, the basin structure promotes groundwater flow ultimately toward Moses Lake, which is several miles southeast of the landfill.

### *4.1.3 Buried Drums and Geophysical Investigation*

Two thousand drums reportedly containing industrial waste were reportedly stacked and covered at the north end of the landfill in 1975 (**Figure 2**). The wastes were reported as "solidified paint sludge, organics, inorganics, and solvents from manufacturing sources". A one-time deposition of un-rinsed pesticide containers is also reported. The location of the drums was verified by interviews with landfill personnel and a magnetic gradiometer survey conducted in September 1990 (B&V and PGG, 1990b). The magnetic survey was concentrated in an area surrounding the identified location. The results of the survey showed a series of strong magnetic anomalies outlining a NW-SE trending feature in the area identified by the landfill personnel. Interpretation of the magnetic survey suggests the main stack of drums is approximately 110-220 feet in length with a width of about 35 feet.

The geophysical survey was extended off-site, north of the landfill fence. No drums or conductive materials were indicated north of the landfill.

### *4.1.4 Site Hydrogeology*

Current understanding of the hydrogeologic setting, groundwater flow paths, sources of contamination, and potentially impacted aquifers is based on surveyed boring logs and groundwater sampling data collected since monitoring of the landfill began in 1989.

The site lies within the Quincy basin of the Columbia Plateau physiographic province. The plateau is characterized by a thick sequence of fine-grained and dense basalt flows, collectively known as the Columbia River Basalt Group. The younger flows comprise the Yakima Basalt Subgroup, which is present in the Ephrata area and is divided into three formations (from youngest to oldest), Saddle Mountain, Wanapum, and Grande Ronde Basalts. The Wanapum Basalt crops out in the study area.

Sedimentary rocks interbedded with the basalt flows are collectively known as the Ellensburg Formation and consist of fluvial and lacustrine sediments and layers of volcanic ash. The Vantage Member crops out near Ephrata.

Unconsolidated sediments overlying the basalts in the Quincy basin include coarse gravels and sands deposited by glacial melt-water, alluvium, and loess. These deposits occur at or near land surface.

Three aquifers are currently monitored at the site: the Outwash aquifer, the Roza aquifer, and the Interflow aquifer (**Figure 3)**. The three aquifers were identified in the original hydrogeologic assessment as the upper-most aquifers below the landfill that could transmit contaminants from the landfill past the point of compliance established for solid waste monitoring purposes (B&V and PGG, 1990a and 1990b).

The Roza and Interflow aquifers occur in permeable weathered zones within the upper parts of the Wanapum Basalt. A weathered interflow zone between two basalt flows within the Roza Member of the Wanapum comprises the Roza aquifer, and the underlying weathered contact between the Roza Member and underlying Frenchman Springs Member comprises the Interflow aquifer. The Outwash aquifer occurs in the saturated sands and gravels that overlie the Wanapum Basalt.

Deeper basalt aquifers (greater than 300 ft below ground surface - bgs) occur within the Frenchman Springs Member of the Wanapum Basalt and within the even deeper Grand Ronde Basalt beneath the site, as indicated by deep water supply wells (decommissioned 33E1; Atkins New (32A2) and 33M1). The Frenchman Springs aquifer is defined as a water bearing zone in the lower portion of the Frenchman Springs Member screened by wells 33E1 and 32A2. Well 33M1 is screened in a water bearing zone within the Grand Ronde Basalt. Transport of contaminants to these deeper aquifers is possible through natural pathways, but sampling in well 32A2 and 33M1 indicates low concentrations of possible site contaminants. The anisotropic sequence of basalt aquifers and aquitards

promotes horizontal contaminant migration and high dilution rates within deep aquifers. Historical vertical migration is likely through the old landfill supply well 33E1 which penetrated the Roza aquifer, Interflow aquifer, and deeper Frenchman Springs aquifer with an open borehole until May 1986. At that time the well seal was extended downward by cementing. Well 33E1 was pressure grouted and decommissioned in 1993 because of continued evidence of contamination. The deeper aquifers are not currently monitored at the site.

#### 4.1.4.1 Basalt Surface

The surface of the Wanapum Basalt (**Figure 2**) is irregular and outcrops in the northern part of the site at an elevation of about 1260 ft. Two subsurface depressions about 10 to 20 feet deep occur in the basalt surface beneath the old landfill (**Figure 2**). The larger depression has been called "the Hole." The basalt surface slopes gradually towards the south-southeast to an elevation of about 1160 feet in the southeast corner of the site near the new landfill. The basalt surface also slopes west towards a buried north-south trending coulee (scour-channel) along Highway 28 to an elevation of about 1140 ft (or a depth of about 90 ft below ground surface). Just west of the landfill this coulee is filled with about 35 ft of silt/clay over gravel in the vicinity of MW-18a. The silt/clay was mined at the location of the "clay pit" just south MW-18a.

#### 4.1.4.2 Groundwater in the Hole

Groundwater in the Hole at EW-1 occurs as an unconfined aquifer of limited lateral extent and is contaminated by leachate (see groundwater quality data below). The aquifer occurs in a sediment-refuse mix in the bottom of the Hole. The aquifer is bounded by low-permeability basalt, which forms the underlying and lateral margins of the Hole. The bottom elevation of the aquifer occurs at about 1227 ft (bottom of the depression) and the top is defined by the water table which fluctuates seasonally from about 1232 to 1234 ft. The aquifer is hydraulically separated somewhat from the underlying Roza (upper-most basalt) aquifer and is the uppermost water-bearing interval in the northern end of the landfill.

The lateral extent of the aquifer in the Hole is likely limited by the side walls of the depression which appear to rise up to 1240 ft (above the highest water level measured in the Hole). However, this is not conclusive because there are not enough depth to bedrock data to resolve the detailed structure. Lateral pathways out of the Hole could occur within unidentified erosion channels in the basalt surface. The most likely direction for such an erosional channel appears to be southwest (**Figure 2).** There may also be other locations within the northern part of the site where saturation occurs above the basalt surface, either within isolated depressions or connected through erosional channels. A recently installed gas extraction well (GE-8) on the northern part of the site encountered water at an elevation of 1253 ft, and wet sand and gravel were encountered above the basalt at an elevation of about 1250 ft during drilling of monitoring well MW-4c (**Figure**

**2)**. However, three of the recently installed gas probes and extraction wells (GE-9, GE-32, and GP6) were drilled to the basalt surface on the northern part of the site without encountering water (**Figure 2**), suggesting saturation above the basalt on the northern part of the site is discontinuous and/or ephemeral.

The transmissivity of saturated refuse and outwash in the Hole is between 4,500 gallons per day per foot (gpd/ft) and 5,900 gpd/ft based on drawdown and recovery data from a pump test conducted in EW-1 (PGG, 2002). Significant water level declines will likely occur in this aquifer during extended pumping at EW-1 as a result of its limited lateral extent. Extended pumping at EW-1 will only be possible at very low discharge rates, on the order of 1 to 2 gallons per minute (gpm).

#### 4.1.4.3 Roza Aquifer

The Roza aquifer is the uppermost confined basalt aquifer at the northern end of the Site and is separated from the overlying aquifer in the Hole by basalt. Extraction well EW-2 and all b-series wells are completed in the Roza aquifer.

The top of the Roza aquifer occurs at an elevation ranging from about 1205 to 1220 ft on the northern part of the Site. There is a downward hydraulic gradient between groundwater in the Hole and the underlying Roza aquifer. There is also a downward hydraulic gradient between groundwater in the Roza aquifer and the underlying Interflow aquifer. Groundwater head in the Roza aquifer is up to 50 ft higher than head in the Interflow and Outwash aquifers.

Transmissivity calculated for the Roza aquifer from a pump test of EW-2 (PGG, 2002) ranges from about 6,300 gpd/ft to 188,000 gpd/ft based on a range of aquifer responses observed in EW-2, MW-3b, MW-7b, and MW-9b. The large range in transmissivity represents variations in hydraulic conductivity and aquifer thickness. Transmissivity is greatest near the extraction well and is very low near well MW-5c and decommissioned well MW-8b where the aquifer pinches out and has lower hydraulic conductivity and thickness (**Figure 4**). A representative transmissivity for the aquifer is about 23,000 gpd/ft based on a geometric mean of available data.

Calculated storativity is low, ranging from $3.0 \times 10^{-4}$ to $1.9 \times 10^{-6}$ with a geometric mean of $2.1 \times 10^{-5}$ indicating confined aquifer conditions. However, high water levels appear to correlate with high contaminant concentrations in some of the Roza aquifer wells (see water quality section below), which is most typical for an unconfined aquifer.

The horizontal hydraulic gradient in the Roza Aquifer is relatively flat, with less than 0.5 ft head difference commonly observed between Roza monitoring wells MW-3b, MW-7b, and MW-9b.

The Roza aquifer is highly heterogeneous and is bounded by lateral discontinuities that may act to "hold up" groundwater in the Roza. The aquifer boundaries observed in pumping test data of EW-2 are caused by thinning of the Roza aquifer to the east in the vicinity of decommissioned well MW-8b and to the south in the vicinity of MW-5c (**Figure 4**). The aquifer is also bounded to the west of the landfill in the vicinity of MW-18a by silt within the buried coulee that appears to truncate the aquifer. The upgradient (northern) extent of the Roza aquifer is not defined.

#### 4.1.4.4 Interflow Aquifer

The Interflow aquifer is a confined basalt aquifer that occurs below the Roza aquifer with a top elevation ranging from about 1120 to 1170 feet. It underlies the entire northern part of the landfill, but to the south may sub-crop into the Outwash aquifer in the vicinity of MW-22c and MW-6c.

The horizontal hydraulic gradient in the Interflow aquifer is relatively flat, with less than 1 ft of head difference commonly observed between the Interflow monitoring wells on the site. A downward hydraulic gradient also likely occurs between groundwater in the Interflow aquifer and deeper underlying basalt aquifers.

Groundwater in the Interflow aquifer discharges into the Outwash aquifer along a subsurface erosional unconformity in the vicinity of MW-22c and MW-6c. Only 2 ft of hard basalt occurs between the Outwash aquifer and the Interflow aquifer at MW-22c, and about 10 ft of soft weathered basalt occurs between the overlying Outwash aquifer and the Interflow aquifer at MW-6c. Groundwater elevations and seasonal fluctuations in the Interflow aquifer are very similar to those observed in the Outwash aquifer suggesting good hydraulic connection.

Interflow aquifer transmissivity was measured in three very short aquifer tests at wells MW-4c, MW-5c, and MW-6c. Calculated hydraulic conductivity ranged from 1 ft/day to greater than 28 ft/day at locations with aquifer thicknesses of 11 to 20 feet. Storativity was not calculated; however, storativity similar to the Roza aquifer is expected.

The Interflow aquifer is screened and sampled by the c-series wells at the site.

#### 4.1.4.5 Outwash Aquifer

The Outwash aquifer is an unconfined aquifer that occurs in saturated sands and gravels that overlie the basalt surface on the south end of the landfill and to the west of the site beneath Highway 28 in the buried coulee. The Outwash aquifer is recharged by canal leakage and lateral groundwater flow from the Interflow and/or Roza aquifers where they sub-crop to the outwash sediments.

The horizontal hydraulic gradient in the Outwash aquifer is relatively flat, with less than 0.5 ft of head difference commonly observed between all the Outwash aquifer monitoring wells on the Site. The vertical gradient between the Interflow and Outwash aquifer is also low and may vary with the irrigation seasons.

A single, brief, low-stress aquifer test at MW-6a suggests an aquifer hydraulic conductivity on the order of 110 ft/day. The Soil Survey of Grant County estimates a hydraulic conductivity of nearly 300 ft/day. Estimates of storativity are not available for the Outwash aquifer, but are likely consistent with unconfined aquifer conditions.

The Outwash aquifer is screened and sampled by the a-series wells at the site.

#### 4.1.4.6 Groundwater Flow Paths

Groundwater recharges the aquifers beneath the site mainly from lateral groundwater flow moving into the site from the north (**Figure 4**). The Roza aquifer has the highest on-site groundwater head and is limited to the northern part of the landfill. Groundwater from the Roza discharges vertically downward to the Interflow aquifer and possibly to the west into the Outwash aquifer where the buried coulee truncates the Roza aquifer. However, poor hydraulic connection to the Outwash and Interflow aquifers limits groundwater discharge rates from the Roza aquifer and causes heads within it to be about 50 ft higher relative to other on-site aquifers. The poor hydraulic connection is caused by pinch-out of the Roza aquifer to the south and east, and by the presence of silt abutting the aquifer in the buried coulee to the west.

Groundwater in the Interflow aquifer moves generally towards the south (**Figure 4**) and may sub-crop in the vicinity of MW-22c and MW-6c where it discharges into the Outwash aquifer. Some vertical flow also likely occurs to underlying basalt aquifers.

Groundwater in the Outwash aquifer is derived mainly from surface sources (leaking canal and irrigation) and discharging groundwater from the sub-cropping basalt aquifers on and off site. Flow direction is generally towards the south (**Figure 4**). The horizontal gradient in all aquifers is quite low (less than 0.5 ft difference between aquifer wells across the site) and variations in flow directions are pronounced.

## 4.2 GROUNDWATER QUALITY

Groundwater monitoring data have been collected from the site since 1989. Groundwater quality, trends, and possible sources of contamination and transport for each aquifer are discussed below. The order of presentation is generally upgradient-to-downgradient, although the Outwash aquifer (presented last) is not downgradient of the Frenchman Springs aquifer (presented second to last). For comparison purposes, **Tables 1, 2, and 3** summarize all constituents known to exceed either State Groundwater Contaminant

Levels (GWCL) from WAC 173-200 or MTCA Method B WAC 173-340-720 cleanup levels, except for samples from the Frenchman Springs aquifer. The GWCLs are the threshold concentrations that establish a corrective action requirement under the solid waste permitting regulation WAC 173-351 (and other State waste discharge permit programs). The MTCA cleanup levels are used within corrective action programs to define the extent of the cleanups. Since the purpose of Tables 1, 2, and 3 is to identify a preliminary set of contaminants of concern for the RI/FS, both the GWCL and MTCA Method B criteria are used therein; however, for purposes of defining cleanup requirements within this RI/FS, only the MTCA Method B cleanup levels will be used.

### *4.2.1 The Hole*

Sampling of extraction well EW-1 (the Hole) in 2001 for organic and inorganic compounds (**Table 1**) showed high concentrations of leachate indicator parameters (e.g., total dissolved solids (TDS), chloride, sulfate, iron, manganese, and sodium). The 2001 sampling round also showed elevated concentrations of volatile organic compounds (VOCs) including vinyl chloride at up to 61 micrograms per liter (ug/L). Vinyl chloride concentrations increased from 21 ug/L to 61 ug/L during the 26-hour pumping test at EW-1, likely due to the variable nature of refuse material surrounding the extraction well.

### *4.2.2 Roza Aquifer*

In general, the Roza aquifer contains lower concentrations of leachate indicator parameters compared to groundwater in the Hole at EW-1. In the vicinity of MW-3b, MW-7b, and MW-9b, the Roza aquifer is contaminated with numerous VOCs including 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), chloroethane, 1,2-dichloropropane, vinyl chloride, benzene, and 1,4-dichlorobenzene at concentrations that recently exceeded GWCL and/or MTCA method B cleanup standards (**Table 1**). MW-3b and MW-7b are also contaminated with methylene chloride at concentrations exceeding the standards, and MW-9b is contaminated with tetrachloroethene (PCE) and trichloroethene (TCE) at concentrations exceeding the standards. Chloroethane and vinyl chloride are likely breakdown products of source chlorinated solvents. In general MW-3b and MW-7b have higher concentrations of organic compounds than MW-9b (except for PCE and TCE) suggesting the main source of contamination is closer to these wells.

Extraction well EW-2 (Roza aquifer) was sampled for VOCs during a single pump test in 2001 (**Table 1**). 1,1-DCA, 1,2-DCA, chloroethane, 1,1-DCE, PCE, TCE, vinyl chloride, and 1,2-dichloropropane were detected at levels above the GWCL and/or MTCA method B cleanup standards (**Table 1**).

A number of geochemical indicators suggest natural attenuation of organic compounds is occurring within the Roza aquifer at the site, although the details/causes of the attenuation are not clear. Time series plots of most chlorinated organic compounds show

a general decreasing trend to lower levels and or non-detects over time since monitoring began in these wells. A distinct decrease in trichloroethane (TCA) and 1,1-DCA with a corresponding increase in chloroethane in MW-3b and MW-7b suggest natural dechlorination reactions are occurring in the aquifer at these locations. A corresponding rise in total iron in these wells may indicate iron reduction is the dominant redox reaction occurring.

There is evidence that the source of VOC contamination may occur as a free product or other residual in the unsaturated zone above the water table. A noticeable relationship between short-term increases in organic contamination concentrations and above-normal groundwater levels is evident in all three wells suggesting the presence of a smear zone at the capillary fringe. This observation is not expected given the nominally "confined" nature of the Roza aquifer.

High concentrations of inorganic constituents also occur in the Roza aquifer. Chloride, sulfate, and corresponding total dissolved solids (TDS) in MW-3b, MW-7b, and MW-9b all exceed the GWCL and/or MTCA method B cleanup standards (**Table 1**). Sulfate and TDS concentrations also exceed the standards in off-site Roza well MW-19b. Dissolved arsenic, total iron and total manganese exceed the standards in some of the Roza wells (**Table 1**). The concentration of arsenic across the site is fairly constant in all aquifers and is likely a naturally occurring contaminant. High levels of total iron and total manganese in the Roza aquifer wells may be related to the low redox state of the aquifer.

The source of contamination in the vicinity of Roza aquifer wells MW-3b, MW-7b, and MW-9b is likely a combination of solvents, pesticides, petroleum products, and leachate. With the exception of PCE and TCE these contaminants likely occur in higher concentrations in the vicinity of MW-3b and MW-7b with mass transport possibly carrying contaminants down-gradient to MW-9b. A separate source of PCE and TCE may occur nearer to MW-9b.

### *4.2.3 Interflow Aquifer*

Low levels of VOC groundwater contamination occur in the Interflow aquifer beneath the site. Interflow aquifer wells MW-2c, MW-5c and MW-22c have concentrations of 1,1-DCA and PCE that marginally exceeded GWCL and/or MTCA method B cleanup levels recently (**Table 2**). MW-5c also has concentrations of 1,2-DCA, 1,2-dibromoethane, TCE and 1,2-dichloropropane marginally exceeding the standards. MW-22c also has concentrations of TCE marginally exceeding the standards. Except for PCE and TCE in MW-5c and MW-22c the concentrations of VOCs in these wells are three to four times lower than the concentrations found in the Roza aquifer wells described above.

Concentrations of VOCs in the Interflow aquifer are relatively constant or slightly increasing over time. A few low level VOC detections occurred in MW-6c and MW-4c

in the mid to late 1990's, but currently there are no organic compounds from these wells above the detection limit. The two other interflow aquifer wells, MW-20c and MW-21c, are located off-site to the northwest and west respectively, and except for some low levels of polycyclic aromatic hydrocarbons (PAH) detected in MW-20c in 2000 and 2001, these wells show no detections of organic compounds.

The source of VOC contamination in MW-2c, MW-5c, and MW-22c is likely from vertical movement of contaminated groundwater from the overlying Roza aquifer. MW-2c is located east of the old landfill, MW-5c is located west of the old landfill, and MW-22c is located south of the old landfill upgradient of the new landfill.

Chloride concentrations in MW-2c, MW-5c, and MW-22c have increased over time since monitoring began, with levels in MW-2c and MW-5c exceeding GWCL and/or MTCA method B cleanup levels (**Table 2**). The source of chloride is likely leachate from the old landfill following the same pathway as the VOCs.

Nitrate concentrations in off-site monitoring well MW-21c are currently an order of magnitude higher than any other monitoring well (on and off-site) and exceed GWCL and/or MTCA method B cleanup levels (**Table 2**). Nitrate levels in this well have increased from below 10 to over 70 mg/L since monitoring of this well began in 2000. The source of nitrate contamination may be the manure from the old chicken farm up-gradient to the north, or some other off-site source. An on-site source is highly unlikely given the flow directions and chemical concentration gradients. The groundwater migration pathway of nitrates to MW-21c is not known at this time. Nitrate concentrations in the overlying Outwash aquifer in the vicinity of MW-21c (MW-17a and MW-18a) are relatively low (below 5 mg/L as N). Total manganese concentrations in MW-21c also exceed GWCL and/or MTCA method B cleanup levels (**Table 2**), but have shown a declining trend from 1000 to 250 mg/L since monitoring began in 2000.

It is currently not known whether organic or inorganic contaminants occur at concentrations above standards down-gradient of wells MW-2c, MW-5c, and MW-22c in the Interflow aquifer on the site.

### *4.2.4 Deeper Basalt Aquifers*

Deeper basalt aquifers (greater than 300-ft bgs) occur below the Interflow aquifer, but are not currently monitored. Vertical transport of contaminants to the Frenchman Springs aquifer occurred historically and locally through the open borehole of 33E1. Vertical migration through vertical fractures in basalt aquitards is also possible, but not dominant given the thick sequence of basalt aquitards separating the aquifers.

Groundwater quality data for the Frenchman Springs aquifer are available from three nearby locations: wells 33E1 (old landfill supply well), 33M1 (new landfill supply well),

and 32A2 (Atkins new well). Water pumped from 33E1 in 1989 contained inorganic and organic contaminants at concentrations well above cleanup levels, and in some cases similar to concentrations in the Roza aquifer (B&V and PGG, 1990b) which should have been sealed-off in that well as a result of seal improvements in 1986. The high concentrations suggest that the seal improvements of 1986 were not successful in preventing vertical migration of Roza groundwater within the borehole. Therefore, these groundwater quality data are representative of water in the 33E1 well bore at that time, but not the Frenchman Springs aquifer in general. Although the concentrations from that sample do not reflect general deep aquifer conditions, they do indicate a point-source of contamination to the Frenchman Springs aquifer at the location of 33E1 beginning in 1974 and extending until 1993 when the well was pressure grouted and decommissioned.

Atkins' new well (32A2) was sampled in 1986 for seven inorganic parameters (NHS Inc. 1986), and in 1989 for volatile organic parameters (B&V and PGG, 1990b). The inorganic data do not clearly indicate the presence of landfill contaminants; however, three volatile organic compounds were estimated to occur (in the absence of blank contamination) below the practical quantitation limit and below cleanup levels.

Water quality samples collected during installation of new landfill water supply well 33M1 contained low levels of benzene (1.3 ug/L) and tetrachloroethene (1.7 ug/L) in the Frenchman Springs aquifer (PGG, 1993). A general lack of benzene in the upgradient Interflow aquifer, and the potential presence of benzene in air and fluids circulated during drilling of 33M1, suggest the benzene in the sample may not have been derived from the aquifer. However, a pathway through the 33E1 borehole that directly connected the Roza and Frenchman Springs aquifers could explain the presence of benzene. Tetrachloroethene is documented within both the Roza and Interflow aquifers.

### *4.2.5 Outwash Aquifer*

Low level VOC contamination is currently evident in Outwash aquifer well MW-6a. However, in 1999 and 2001 there were also detections of PCE in MW-10a, MW-11a, and MW-14a, and detections of TCE in MW-14a, which were marginally above the MTCA-B standard. MW-18a was sampled for VOCs in June 2000, October 2000, and April 2001. Results of those samples showed concentrations of 1,1-DCA marginally above the State groundwater quality and/or MTCA method B cleanup levels (**Table 3**). MW-18a has not been sampled for VOCs since 2001.

MW-6a is currently monitored and contains concentrations of PCE and 1,1-DCA at levels marginally above the GWCL and/or MTCA method B cleanup levels (**Table 3**). Sampling in 2000 and 2001 also indicated 1,1-DCE marginally above the standards and sampling in 1999, 2000 and 2001 indicated TCE marginally above the standards.

The source of low level VOC contamination in the Outwash aquifer may be from contaminants migrating in the Roza and Interflow aquifers and then discharging into the Outwash aquifer where the basalt aquifers sub-crop into the outwash.

MW-6a also contains concentrations of chloride, nitrate, TDS, and dissolved arsenic above the GWCL and/or MTCA method B cleanup standards (**Table 3**). MW-6a began a sudden increasing trend in a number of inorganic parameters in July 2003, including chloride, nitrate, barium, calcium, cobalt, copper, magnesium, nickel, and sodium. The source of the increase may be from enhanced leaching of fertilizers applied to poplar trees planted along the property boundary in 2002, or from enhanced leaching of refuse from water applied to a large fire that occurred in 2002. No other wells have shown a similar sudden increase.

Elevated concentrations of arsenic occur in all outwash aquifer wells at levels exceeding the GWCL and/or MTCA method B cleanup level (**Table 3**). The concentration of arsenic across the site is elevated and fairly constant within each aquifer, suggesting a naturally occurring constituent.

Except for one sampling event in 2001 for bis(2-ethylhexyl) phthalate in MW-14a which exceeded the GWCL, no organic constituents have been detected above the standards in down-gradient Outwash aquifer wells MW-1a, MW-10a, MW-11a, MW-14a and MW-23a. Also, total iron, total manganese, and TDS are the only inorganic parameters, besides naturally occurring arsenic, which occasionally exceed the GWCL in some of these wells (**Table 3**), suggesting no transport of contaminants has occurred in the Outwash aquifer off site to the south.

Transport of contaminants in the Outwash aquifer off site to the east beyond MW-6a is not known. Transport of contaminants in the Outwash aquifer off site to the west beyond MW-18a is also not well known. However, MW-17a (located southwest of MW-18a) was sampled for VOCs in 2000, 2001, and 2004. Results of those samples indicated low concentrations of 1,1 DCA and 1,2 dichloropropane in 2000 and 2001 below the State groundwater quality and/or MTCA method B cleanup levels, but in 2004 no organic constituents were detected, suggesting contaminant transport in the Outwash aquifer beyond MW-18a is minimal.

## 4.3 PRELIMINARY CONTAMINANTS OF CONCERN

Extensive groundwater quality monitoring at the site indicates a number of chlorinated organic compounds, semi-volatile organic compounds, fuel compounds, and inorganic contaminants occur in one or more aquifers beneath the Site. To facilitate the RI/FS, a preliminary list of Contaminants of Concern (COCs) has been generated (**Table 4**).

Finalized COCs and other indicator parameters, as well as a list of analytical methods, will be defined within the sampling and analysis plan (Section 5.1 below).

The criteria for listing a parameter as a preliminary COC is that the parameter continues to exceed either GWCL or MTCA-B clean up levels (**Tables 1-3**). Exceptions to this criteria are 1,1-dichloroethene, chloromethane, and toluene, which have exceeded MTCA-B cleanup levels at least once in the past and are considered important parameters for understanding the fate and transport of particular families of organic compounds. The GWCLs are the threshold concentrations that establish a corrective action requirement under the solid waste permitting regulation WAC 173-351 (and other State waste discharge permit programs). The MTCA cleanup levels are used within corrective action programs to define the extent of the cleanups. Since the purpose of Tables 1, 2, 3 and 4 is to identify a preliminary set of contaminants of concern for the RI/FS, both the GWCL and MTCA Method B criteria are considered; however, for purposes of defining cleanup requirements within this RI/FS, only the MTCA Method B cleanup levels will be used.

Chloride, sulfate, and total dissolved solids are included in the preliminary COC as indicator parameters, and nitrate is included to investigate site-wide nitrate trends.

The COC list is only one group of analytes to be used for the RI/FS. Other groups include parameters indicative of geochemical conditions and natural attenuation, and parameters necessary to support analysis of remedies in the FS.

## 4.4 EVALUATION OF CLEANUP REQUIREMENTS UNDER MTCA

Cleanup levels, points of compliance, and cleanup actions will be defined based on the RI/FS and in accordance with the MTCA regulation and the WAC 173-351 permit for continued use of the site for solid waste management. The sole basis for cleanup of groundwater will be MTCA cleanup requirements. Although actions to prevent ecologic and human health risks from direct soil contact and landfill gas contact will also meet MTCA standards, actions for those pathways have already been designed, primarily using solid waste engineering criteria and regulations (under WAC 173-351). Direct contact with soils will be prevented by capping the landfill, and landfill gas will be passively vented and flared (thermally destroyed).

The 2,000 drums and/or hazardous material derived from the drums that constitute a potential continuing source of contamination will be removed to the extent practical in an interim remedial action defined in the Interim Remedial Action Plan. If during removal of drums surrounding soils are impacted, soil removal will be performed based on protection of groundwater and not soil direct contact.

As an interim action, the old landfill will be capped with natural and synthetic materials in accordance with engineering plans and specifications to be approved by Grant County Health District and Ecology. The cap will prevent wildlife and plants from being exposed to hazardous substances and will therefore likely meet the requirements for an exclusion from a terrestrial ecological evaluation according to WAC 173-340-7491(1)(b). An assessment of conformance with the exclusion requirements will be provided as part of the remedial investigation work described below.

Although removal of "hot spots" within the landfill refuse may be selected as a remedial action based on the results of the RI/FS, refuse within the municipal solid waste landfill will not be considered "soil" for the purposes of applying the MTCA regulation. Geologic materials surrounding the refuse in the vertical and lateral directions will be considered "soil." These definitions will not reduce the PLP's obligations to meet cleanup levels for soil and groundwater. Soil hot spot removal within the landfill cap area, if performed, will be based on protection of groundwater.

Under MTCA, the standard point of compliance for groundwater would be throughout the site from the uppermost level of the saturated zone extending vertically to the lowest depth which could potentially be affected by the site. However, it is likely that it is not practicable to meet the groundwater cleanup levels at the standard point of compliance within a reasonable restoration timeframe. Therefore, a conditional point of compliance on County property will likely be proposed in accordance with WAC 173-340-720(c). Cleanup levels for groundwater will be based on drinking water criteria as implemented in MTCA Method B (WAC 173-340-720).

## 4.5 REVIEW OF POTENTIAL EXPOSURE PATHWAYS

To fill data gaps, and meet MTCA RI/FS information requirements, this section reviews the status of potential exposure pathways. The pathways are considered to be either not present currently, rendered inactive by proposed interim actions (landfill capping and landfill gas venting and destruction), or potentially active after interim action.

| Potential Exposure Pathway | Status at Ephrata Landfill |
|---|---|
| Landfill gas to groundwater to human contact/ingestion | Potentially active |
| Soil to groundwater to human contact/ingestion | Potentially active |
| Soil to groundwater to off-site surface water (direct human or animal contact with off-site surface water) | Potentially active |
| Direct human or animal contact with landfill gas | Inactive after interim action (landfill gas control) |
| Direct human or animal contact with soil | Inactive after interim action (landfill capping). Conformance with standards to be confirmed. |
| Direct human or animal contact with on-site surface water | Not present |

Except for direct exposure to soil, all of the potentially active exposure pathways involve groundwater, which may become contaminated by leaching of soil and refuse or indirectly as a result of diffusion from contaminated landfill gas. Direct exposures to landfill gas and contaminated soil are precluded by the proposed interim actions; however, an RI task will evaluate whether the interim actions support an exclusion from MTCA's terrestrial ecological evaluation requirements. Site contaminants do not directly discharge to surface waters.

## 4.6 DATA GAPS AND SUMMARY OF RI/FS TASKS

The scope of investigation and feasibility study tasks to be performed during the RI/FS complements the existing body of knowledge on the nature and extent of contamination summarized in sections above. The principal uncertainties for the remedial investigation at this time are:

- Detailed knowledge of the source of groundwater contamination within the Roza aquifer at the north end of the landfill.
- The lateral extent of groundwater contamination within the Interflow aquifer.
- Whether or not cleanup levels are exceeded in the Frenchman Springs aquifer.

The combination of prior information and work conducted for the RI/FS will meet the informational standards of MTCA. Principal investigation tasks to fill the data gaps listed above are:

- Observe, sample, and photograph drums removed during the interim action.
- Observe, sample, and photograph soils and rock surrounding drums removed during the interim action.
- Sample soils and/or soil gas in other potential source areas at the north end of the landfill.
- Sample groundwater along the known groundwater pathways between contaminant source areas and downgradient locations with concentrations below MTCA Method B cleanup levels.
- Further evaluate groundwater and contaminant pathways using groundwater level measurements, hydraulic conductivity measurements, and a long term aquifer pumping test.

The feasibility study will evaluate remedial alternatives in compliance with MTCA remedy selection requirements. This analysis will address the effectiveness, implementability, and cost of different cleanup technologies, ranging from aggressive removal technologies to containment and natural attenuation technologies. The presumptive remedy of capping and venting/flaring gas from the old landfill will be incorporated into considerations for additional actions. Where appropriate, the feasibility study will evaluate different remedial technologies for specific areas of the site or for different contamination levels. Specific analyses to be performed during the feasibility study include the following:

- Technology Identification and Screening
- Development of Remedial Alternatives
- Evaluation Criteria for Remedial Alternatives
- Detailed Evaluation of Remedial Alternatives
- Conclusion/Recommended Remedy

# 5 REMEDIAL INVESTIGATION TASKS

This section describes tasks to be undertaken during the remedial investigation. Primary tasks are those that will be performed regardless of additional information. Contingency tasks are those that may or may not be required, depending on the results of primary tasks.

## 5.1 PRIMARY INVESTIGATION TASKS

The following sections describe the primary investigation tasks.

### *5.1.1 Task 1 – Management and Planning*

PLPs will communicate with Ecology, the Health District, and consultants to promote smooth progress toward project goals and to control costs. Communication will be through channels described in the Agreed Order. The following paragraphs describe additional planning documents that will guide the work.

A Combined Sampling and Analysis Plan (SAP) and Quality Assurance and Quality Control Plan (QAP) will be generated to define the details of field investigations, laboratory analyses, and quality assurance measures. They will meet or exceed requirements in WAC 173-340-820 and -830. Finalized COCs and indicator parameters[3] will be defined within the plan, as well as a list of analytical methods. Methods will be specified for a list of parameters to be analyzed in an on-site laboratory during drum excavation and exploration of other possible sources at the north end of the landfill. The draft will be submitted to Ecology for review. PLPs will address Ecology comments and submit a draft final SAP/QAP. Upon Ecology approval, the plan will be final.

A Health and Safety Plan (HSP) will be generated to define protective measures for workers during on-site RI activities. It shall meet or exceed requirements of WAC 173-340-810. The draft will be submitted to Ecology for review and comment. PLPs will address Ecology comments and submit a final SAP/QAP.

### *5.1.2 Task 2 – Investigate Extent of Contamination from Drums*

In addition to engineering observation of the drum removal contractor, a professional will be on site during excavation to document conditions of the drums and surrounding waste, soil, and rock for purposes of the remedial investigation. Field tasks will include:

- Establishing lateral and vertical coordinates of key site features including rock outcrops, drums, and environmental samples.
- Photographing drums, drum labels, surrounding waste and soil, and rock.
- Retrieving and archiving legible drum labels.
- Sampling the contents of drums or other waste volumes for purposes of waste designation and disposal.

[3] Indicator parameters are likely to include constituents of industrial waste and leachate that are not included as COCs, but may assist with identification of the source of groundwater contamination. Possible examples are calcium, chloride, and low molecular weight fatty acids.

- Observing and sampling surrounding waste, soil, and possibly soil gas and rock to assess the limits of excavation and contaminant migration.
- Mapping, describing, and photographing newly-exposed geology.
- Observing moisture and groundwater conditions for purposes of contaminant migration.
- Identifying and locating pathways of contamination that will not be excavated and thus require exploration by other means.
- Performing or assisting with on-site chemical analyses.
- Providing environmental data to the engineering supervisor to aid in setting directions and limits of excavation.
- Assisting with project communication to the county, city, and agencies.

Work will be documented through maintenance of a daily field log, with coordinated logs of samples and photographs. A GPS-based field survey is anticipated, with lateral and vertical precisions of 5 and 2 feet, respectively. Samples will be analyzed for all or some COCs and indicator parameters, depending on the matrix, and appropriate waste designation parameters. An on-site chemical laboratory will be established to quickly analyze samples for a subset of COCs, indicator parameters, and possibly waste designation parameters. The on-site laboratory data will be used to guide further excavation. Project personnel will facilitate a discussion amongst the PLPs and Agencies to agree on the limits of excavation based on field data.

### *5.1.3 Task 3 – Explore for Other Contamination Sources*

Backhoe test pits and soil borings will be used to sample waste and soil over an approximately triangular area at the north end of the landfill between stations MW-8b, GP-5, and MW-7b (**Figure 2**). Results of previous geophysical surveys along the northern part of the landfill (B&V and PGG, 1990b) will be reviewed to help select locations. Sample stations will be on approximately 100-ft centers. Test pits will first be used throughout the flat northwestern-most portion of that area where depth to basalt is anticipated to be less than 10 feet. Samples will be collected from the bucket within each major stratum encountered with a default sampling interval of 5 feet. This strategy should result in about 180 soil samples (including samples from the borings discussed below). The geologist will log and sample materials encountered but will not enter the pits.

A drill rig will be used to explore and sample wastes in areas where basalt is anticipated to be greater than 10 feet deep, and where basalt was not encountered in a test pit. A sonic drill rig will likely be used. General approaches to management of investigation-derived waste, sampling, and chemical analysis techniques will be as for the test pits.

All samples will be split into two aliquots: one for possible on-site analyses, and one for possible analysis by an accredited off-site laboratory. All samples will be screened in the on-site laboratory for total volatile organics, electrical conductance, and possibly other parameters. Off-site analyses of COCs by an accredited laboratory will be assigned by field and management staff based on geologic observations and on-site screening data, with the following goals in mind:

- Establish correlations between screening data and chemical specific analyses – this will require samples over a range of concentrations be analyzed on site and off site.
- Perform accredited analyses of COCs on all significantly contaminated samples.
- Perform accredited analyses of COCs on at least 36 waste/soil samples generated by this task (about 20% of the total number of samples anticipated).

Wastes and soil will be stockpiled on liners next to each test pit and boring. The explorations and wastes will be temporarily secured pending waste screening. Excavated materials that are contaminated based on on-site screening will be disposed to the lined landfill cell. Uncontaminated waste and soil may be used to backfill test pits and borings. Groundwater is not anticipated in the borings; however, if groundwater is encountered, a monitoring well will be constructed in lieu of backfilling[4]. No permanent wells will be allowed within the new landfill access road alignment that will traverse this area.

The locations of all explorations will be surveyed by field staff using GPS.

In addition, soil and landfill gas samples will be collected from temporary samplers installed in borings and test pits, and from permanent gas probes and wells. Samples will be analyzed for volatile organic compounds, COCs, and indicator parameters.

### *5.1.4 Task 4 - Delineate Groundwater Contamination*

Additional groundwater monitoring wells will be installed to delineate areas with exceedences of MTCA cleanup levels in groundwater. Locations for additional wells are summarized below and shown on Figure 2:

- Interflow Aquifer well east of MW-2c on County property
- Interflow Aquifer wells near MW-11a and MW-10a on County property if possible
- Frenchman Springs aquifer well near MW-5c

[4] A variance from well construction standards may be necessary to construct a well through waste.

- Roza aquifer well (vertical) southwest of MW-9b on County property; and two angle core holes projecting under the drums from the north (County property)

Drilling of vertical wells will be performed with an air rotary drill rig. Samples of soils will be described but not retained. Two-inch diameter monitoring wells will be constructed in accordance with WAC 173-160. Drill cuttings will be spread at the wellhead. Wells will be developed for sampling, equipped with Grundfos sampling pumps, and briefly tested to assess aquifer properties and appropriate sampling flow rate.

Groundwater from the boring advanced into the Frenchman Springs aquifer will be sampled at each major aquifer within the Frenchman Springs to a depth of 375 feet, with water analyzed with rapid turnaround for indicator parameters and VOCs. Results of water quality analyses, groundwater head, and the boring log will be used to design either a single completion monitoring well, or a multi-port sampler using the FLUTe (www.flut.com) system or similar. Potential FLUTe sampling ports could extend from the elevation of the (pinched-out) Roza aquifer at about 100 feet depth to the bottom of the boring.

Two angle core borings will be advanced under the drums with the goal of identifying possible vertical contamination migration pathways within basalt that underlies the drums. The borings will be continuously cored within the basalt, with cores logged and stored in boxes. Rock samples or wipe samples may also be analyzed for contaminants if feasible based on field geologist observations. Angles between 30 and 45 degrees from the vertical will be used, with the horizontal dimension toward the south (under the drums).

The borings will be completed as single or multiple-completion groundwater sampling stations using a FLUTe system or similar. A request for variance from WAC 173-160 well construction standards will be submitted for the small diameter and/or multiple completions prior to construction. The field geologist will specify FLUTe construction details based on the core log.

Measuring points will be established at all wells, and be surveyed by a County crew.

New and existing wells will be sampled once for COCs and indicator parameters, and up to three more times (quarterly) for COCs and indicators detected in the first round.

Based on likely remedies for the site, which could include monitored natural attenuation and/or groundwater pump and treat with effluent disposal by evaporation, groundwater sampling will include the following parameters in addition to COCs and indicator parameters:

- Odor (qualitative)
- Dissolved oxygen (using field flow through cell)

- Redox potential (using field flow through cell)
- Sulfide, including H2S (using field flow through cell)
- Total non-methane organic hydrocarbons
- Biological Oxygen Demand (BOD5)
- Metals, as both total and dissolved metals
- Pesticides/Herbicides (specifically including aldrin, chlordane, DDE, DDT, Dieldrin, Lindane, Heptachlor, and hydrazine).
- Aldehydes, including acetaldehyde and formaldehyde
- Ethane/ethene
- Nitrate/Nitrite/TKN
- Total phosphorus and ortho-phosphorus
- Dissolved Methane
- Hydrogen (nM)
- Gasoline/Diesel

For the potential evaporation water disposal remedy, DO, redox, and sulfide are of interest to determine if the groundwater is in a reducing state that might cause significant odors to be released from an open pond. Total non-methane organic hydrocarbons would indicate the maximum quantity of volatile organic compounds that might evaporate. BOD5 would allow the pond to be sized to ensure sufficient surface area to prevent excessive biological growth/anaerobic conditions. Pesticide/herbicides and aldehydes are of interest as these compounds have extremely low air quality standards. Ecology may not allow evaporation of these compounds directly to the atmosphere (treatment may be necessary if they are present). Total metals will be important should the pump and treat effluent be discharged to the City of Ephrata Publicly Owned Treatment Works (POTW). All of the listed parameters would be useful for assessing in-situ bioremediation. Specifically, ethane/ethene are indicators of the successful natural biological dechlorination of contaminants.

### *5.1.5 Task 5 – Exclusion from Terrestrial Ecological Evaluation Assessment*

Once the extent of contamination has been delineated, an assessment conforming to the requirements for an exclusion from the Terrestrial Ecological Evaluation Assessment (WAC 173-340-7491) will be performed. It is anticipated that capping of the old landfill will preclude direct contact of wildlife and plants with contamininated soil and meet the requirements for an exclusion according to WAC 173-340-7491(1)(b).

### *5.1.6 Task 6 – Pump Groundwater from the Hole*

To investigate pathways of contamination in the vicinity of the old landfill, groundwater will be pumped from the Hole for a fixed period of time (to be specified later – but anticipated to be weeks and months duration) or until water treatment and disposal are no longer feasible. Well EW-1 will be pumped at anticipated rates of between 1 and 2 gallons per minute continuously. Drawdown and discharge will be measured in EW-1, with one Roza aquifer well also monitored for drawdown. Measurements of discharge and groundwater levels within and near the Hole will be used to interpret the connectivity of that groundwater body to other bodies and to assess potential contaminant pathways.

Water will be disposed in accordance with the approved SAP, with disposal likely occurring by evaporation in a lined pond. Thus, this test may occur in the spring, summer, and fall months. Air quality permit requirements will be evaluated for this disposal method.

Key water quality parameters will be sampled infrequently over the duration of the test.

## 5.2 CONTINGENCY INVESTIGATION TASKS

Depending on the results of the primary investigation tasks, additional field tasks may be required to meet MTCA remedial investigation standards. Upon completion of the primary investigation tasks (only one round of well sampling), PLPs will summarize field information in a technical memorandum that also identifies remaining data gaps, if any. The memo will be submitted to the Agencies for review and comment. Based on the memo and MTCA information requirements, the PLPs and Agencies shall seek agreement on any further remedial investigation tasks.

# 6 DATA MANAGEMENT, REPORTING, AND QA/QC

The following sections describe how data collected during the remedial investigation will be managed, reported, and quality assured.

## 6.1 DATA MANAGEMENT

The following data management tools will be used to archive all data collected during the remedial investigation:

- Field logs will be photocopied weekly and mailed or faxed to an off-site location.

- A soils and gas database similar to the existing groundwater quality database will be established. Data to be imported into the database will include: coordinates of key site locations; station IDs; and all soil and gas sampling results (both field and laboratory analyses).
- Groundwater quality data will be imported into the existing groundwater database.
- Field photos of drum removal and soil excavations will be categorized and archived digitally.
- Daily field logs documenting field activities, soil pit and borings, and other key observations will be copied and kept on file.
- All borings and well designs will be constructed and archived in a digital format.
- All aquifer pumping test data, including pumping from the Hole, will be input into an MS Excel spreadsheet and time drawdown plots will be constructed.
- Pacific Groundwater Group performs daily backups and monthly archiving of networked hard drive contents. In addition, project directories will be backed-up to compact disks weekly.

## 6.2 REPORTING

Data collected during the primary and subsequent contingency remedial investigations will be summarized in the RI/FS report. The report will include tabular and graphical summaries of all chemical testing data (field and laboratory), test pits and borings, well logs, and aquifer test data.

## 6.3 QA/QC

Standard quality control/quality assurance (QA/QC) procedures of the analytical laboratories such as running laboratory blanks, duplicates, matrix spikes, and surrogate analyses will be performed in accordance with a QA/QC plan included with the sampling and analysis plan. Laboratory reports and QA/QC summaries will be attached to the final RI/FS report as appendices.

# 7 FEASIBILITY STUDY TASKS

The following sections describe tasks to be performed as part of the feasibility study.

## 7.1 TECHNOLOGY IDENTIFICATION AND SCREENING

The FS will identify remedial technologies applicable to the various media and areas at the Site and rank the technologies based on three criteria, as indicated below:

| Criteria | Definition | Rankings |
|---|---|---|
| Technical Feasibility | Engineering issues including the ability of the technology to function effectively and achieve meaningful progress in a timely manner toward remediation goals, based on contaminant characteristics and concentrations and site conditions. | Feasible, Infeasible |
| Implementability | Administrative issues including regulatory approvals, schedule, constructibility, access, monitoring, operation & maintenance, community concerns, and other factors. | Implementability issues will be noted. |
| Cost | Relative cost including capital and future annual operating, maintenance, and monitoring costs. | Low, Medium, High, Prohibitive |

As part of the screening, each technology will be retained or not retained. Retained technologies will be assembled into remedial alternatives. The following presents a preliminary identification and screening of technologies. Technologies are grouped into three general categories:

1. Additional Source Control Elements
    - Excavation of Hot Spots in Refuse – Anticipated to be feasible and implementable, but may be screened out due to high cost.
    - Excavation of all refuse – This technology will be screened out due to implementability concerns and high cost.
    - Active landfill gas treatment (the need for this technology depends on whether the conceptual site model identifies landfill gas migration as a contaminant migration pathway).
2. On-Site Groundwater
    - Monitored Natural Attenuation (MNA) – Retained
    - Groundwater Physical Containment – Anticipated to be screened out as technically infeasible in basalt due to the complex bedrock environment; however, maybe applicable in limited areas of refuse/outwash.

- Groundwater Pump and Treat – Retained
    - Extraction from the Hole year-around, as compared to seasonally for the interim action.
    - Extraction from the Rosa aquifer as needed to provide plume hydraulic containment/treatment.
    - Treatment/Water Disposal Options (The following options will be screened and one option will be carried forward into the remedial alternatives):
        - Extensive Treatment, Disposal by Re-injection/infiltration (no surface water discharge point is available at or near the site).
        - Mid-Level Treatment, Disposal To City of Ephrata POTW
        - No Treatment or Low-Level Treatment, Disposal by Evaporation
- In-situ Treatment – Applicable technologies will be identified, but will likely be screened out as infeasible due to the complex hydrogeology and mix of contaminants.

3. Off-Site Groundwater
    - MNA – Retained.
    - Groundwater Pump and Treat – It is anticipated that groundwater pump and treat from the downgradient Interflow and Outwash aquifers (beyond the landfill property boundary) will be screened out due to high cost. The downgradient aquifers have high transmissivity, resulting in high groundwater pumping rates to control a plume.
    - In-situ Treatment – Will be screened out due to dilute contaminant concentrations in off-site aquifers.
    - Point Source Treatment (well-head treatment)/Alternative Water Supply – Technologies for existing off-site groundwater wells will be identified and screened. Treatment alternatives could include reverse osmosis and/or carbon adsorption (zeolite for vinyl chloride). Alternative water supply technologies could include bottled water or a new well in a deeper aquifer, or extension of public water supply. One treatment or alternative water supply option will be selected.

## 7.2 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The second stage of remedy evaluation within the FS will be to present the remedial alternatives developed from the technologies that passed the screening process and identify fundamental assumptions and design parameters that will be applied to all alternatives. These items include specific average and maximum concentration for each contaminant, landfill leachate release rates, aquifer and groundwater physical parameters, groundwater travel times, and similar factors. The remainder of the section will be devoted to describing each remedial alternative, including providing feasibility study level design parameters and costs of remedial actions and treatment systems, estimating the time to reach cleanup levels, identifying appropriate institutional controls, and discussing implementability factors, advantages, and disadvantages. Probable remedial alternatives are:

| Alternative | No Action | Waste Hot Spot Removal | Active LF Gas System* | MNA On-Site | MNA Off-Site | On-Site GW Pump/Treat (Hole – annually vs seasonable for IRA) | On-Site GW Pump/Treat (Roza) | Well-head Treatment/Alternative Water Supply |
|---|---|---|---|---|---|---|---|---|
| Alt. 1 - No Action | X | | | | | | | |
| Alt. 2 – MNA I | | | | X | X | | | X |
| Alt. 3 – MNA II | | X | X | X | X | | | X |
| Alt. 4 – Pump & Treat I | | | | | X | | X | X |
| Alt. 5 – Pump & Treat II | | | | | X | X | X | X |
| Alt. 6 – Pump & Treat III | | X | X | | X | | X | X |

* Use of Active LF Gas System depends on the differences between performance of passive and active systems.

The description of MNA for Alternatives 2 and 3 will address the criteria for natural attenuation listed in WAC 173-340-360. Groundwater capture zones for the groundwater pump and treat alternatives will be determined through groundwater modeling. Cost estimates and conceptual designs will be prepared for each alternative. The format of the cost estimates will allow for direct comparison of costs between each alternative,

and will include initial capital and future operation, monitoring, and maintenance costs based on the estimated duration of the remedial action.

## 7.3 EVALUATION CRITERIA FOR REMEDIAL ALTERNATIVES

The third step in the FS will identify and define the remedial alternative evaluation criteria in accordance with MTCA requirements. These criteria are:

- Overall protection of human health and the environment
- Compliance with ARARs
- Short-term effectiveness
- Long-term effectiveness
- Reduction of toxicity, mobility, and volume through treatment (permanence)
- Implementability
- Cost
- Community concern

## 7.4 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

The fourth step of the FS will evaluate the remedial alternatives using the remedial alternative evaluation criteria. Each alternative will be evaluated using each criterion with a scoring system of 1, 2 or 3. The scoring system will be defined in the text. Costs will be compared (as present worth costs). A disproportionate cost analysis will be prepared to evaluate the relative benefits and costs of the alternatives. The analysis will be completed in accordance with MTCA guidance.

## 7.5 CONCLUSION/RECOMMENDED REMEDY

The final FS step will provide conclusions of the FS and recommend a remedy based on remedial alternatives evaluation.

# 8 PREPARATION OF THE RI/FS REPORT

The RI/FS report will be prepared as a draft for review and comment by Ecology. Ecology will provide written comments on the RI/FS report and written responses to these comments will be provided by the PLPs. After the comments from Ecology have been addressed, a revised RI/FS report will be prepared to reflect the comments and responses from the draft RI/FS. This version of the RI/FS will be made available for

public and stakeholder review during a 30-day public comment period. The RI/FS will be finalized after completion of a public comment period.

# 9 PROJECT SCHEDULE ISSUES

A firm project schedule cannot be established without considering coordination of RI and interim action field tasks, and management issues. The following key schedule issues are identified to assist in overall project schedule development:

- Drum removal must be contemporaneous with evaluation of environmental conditions near the drums (RI Task 2).
- Exploration for other contamination sources should follow drum removal.
- Disposal of water pumped from the hole will be by evaporation and thus limited to spring, summer, and fall.
- Contingency tasks must follow submittal and discussion of all primary RI tasks (but only one round of groundwater sampling), removal of drums, and one season of pumping water from the hole.

# 10 REFERENCES CITED


B&V Waste Science and Technology Corp and Pacific Groundwater Group. 1990a. *Ephrata Landfill Geophydrologic Assessment Report.* Consultant's report prepared for Grant County Public Works as part of the WAC 173-304.

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Pacific Groundwater Group. 1993. *Well Completion Report, Well No. 33M1, Ephrata Landfill, Grant County, Washington.* Consultant's report prepared for Grant County Public Works.

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Walters, K.L. and Grolier. 1960. *Geology and Ground Water Resources of the Columbia Basin Project area, Washington Vol. 1,* Washington State Water Supply Bulletin 8.

**TABLE 1: Summary of Constituents Exceeding Groundwater Contaminant Levels (GWCL) and MTCA Method B in The Roza Aquifer**
**Grant County Ephrata Landfill (October 1989 through December 2005)**

| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | ROZA WELLS Atkins Old | EW-1 "Hole" | EW-2 | MW-19b | MW-3b | MW-7b | MW-9b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | | | | | | | |
| Chloride | 250 | | | mg/L | Total Samples | 40 | 3 | 3 | 18 | 44 | 37 | 41 |
| | | | | | Max Value | 17.4 | 1800 | 960 | 30 | 1510 | 1180 | 2060 |
| | | | | | Min Value | 2.5 | 1600 | 880 | 18.4 | 70.5 | 9 | 42.48 |
| | | | | | Most Recent Value | 9.8 | 1600 | 960 | 20.1 | 472 | 276 | 1260 |
| | | | | | GWCL Exceedances | 0 | 3 | 3 | 0 | 36 | 29 | 39 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrate as Nitrogen | 10 | | | mg/L as N | Total Samples | 25 | 3 | 3 | 17 | 29 | 25 | 28 |
| | | | | | Max Value | 3.2 | ND | 0.69 | 0.047 | 2.01 | 6.39 | 20.1 |
| | | | | | Min Value | 0.004 | ND | 0.56 | ND | ND | ND | 0.016 |
| | | | | | Most Recent Value | 0.776 | 0 | 0.66 | 0.01 | 0.01 | 0.296 | 0.566 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrite as Nitrogen | 10 | | | mg/L as N | Total Samples | 25 | 3 | 3 | 17 | 29 | 25 | 28 |
| | | | | | Max Value | 27.1 | ND | 0.064 | 0.01 | 0.02 | 0.056 | 0.354 |
| | | | | | Min Value | ND | ND | 0.032 | ND | ND | ND | 0.021 |
| | | | | | Most Recent Value | 0.01 | 0 | 0.064 | 0.01 | 0.01 | 0.05 | 0.093 |
| | | | | | GWCL Exceedances | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sulfate | 250 | | | mg/L | Total Samples | 40 | 3 | 3 | 18 | 45 | 37 | 41 |
| | | | | | Max Value | 41.2 | 1200 | 1100 | 1020 | 1560 | 990 | 1790 |
| | | | | | Min Value | 0.525 | 1100 | 1100 | 290 | 1.689 | 2.216 | 2.935 |
| | | | | | Most Recent Value | 20.8 | 1200 | 1100 | 573 | 142 | 187 | 328 |
| | | | | | GWCL Exceedances | 0 | 3 | 3 | 18 | 28 | 25 | 38 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Dissolved Solids | 500 | | | mg/L | Total Samples | 34 | 3 | 3 | 18 | 34 | 31 | 32 |
| | | | | | Max Value | 690 | 5100 | 3000 | 1750 | 5360 | 6850 | 11200 |
| | | | | | Min Value | 200 | 4400 | 2900 | 959 | 326 | 1350 | 440 |
| | | | | | Most Recent Value | 230 | 4400 | 3000 | 959 | 2040 | 1350 | 4020 |
| | | | | | GWCL Exceedances | 1 | 3 | 3 | 18 | 33 | 31 | 31 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Organics** | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | 200 | | 7200 | ug/l | Total Samples | 34 | 3 | 3 | 20 | 33 | 31 | 32 |
| | | | | | Max Value | 0.49 | ND | ND | ND | 390 | 440 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 1 | 2 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,1-Dichloroethane | 1 | | 800 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | ND | 11 | 24 | ND | 1200 | 340 | 25 |
| | | | | | Min Value | ND | 4.3 | 21 | ND | ND | 2.6 | ND |
| | | | | | Most Recent Value | ND | 11 | 21 | ND | 11 | 16 | 11 |
| | | | | | GWCL Exceedances | 0 | 3 | 3 | 0 | 40 | 34 | 34 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1,2-Dichloroethane (EDC) | 0.5 | 0.48 | 160 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | ND | ND | 3.1 | ND | 310 | 170 | 4.5 |
| | | | | | Min Value | ND | ND | 2.8 | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | 2.8 | ND | 2.2 | 3.7 | 1.6 |
| | | | | | GWCL Exceedances | 0 | 0 | 3 | 0 | 38 | 32 | 28 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 3 | 0 | 38 | 32 | 28 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 2 | 1 | 0 |
| Chloroethane | | 15 | 3200 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 39 | 34 | 35 |
| | | | | | Max Value | ND | 3.3 | 21 | ND | 580 | 810 | 17 |
| | | | | | Min Value | ND | 1.8 | 17 | ND | 0 | ND | ND |
| | | | | | Most Recent Value | ND | 3.3 | 17 | ND | 350 | 140 | 12 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 3 | 0 | 21 | 18 | 1 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,1-Dichloroethene | | 0.073 | 40 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | ND | ND | 1.1 | ND | 6.6 | 110 | 3.2 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 1 | 0 | 20 | 17 | 14 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | ROZA WELLS Atkins Old | EW-1 "Hole" | EW-2 | MW-19b | MW-3b | MW-7b | MW-9b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tetrachloroethene (PCE) | 0.8 | 0.081 | 80 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | 0.64 | ND | 2 | ND | 1.3 | 1.2 | 21 |
| | | | | | Min Value | ND | ND | 1.4 | ND | ND | ND | 3.4 |
| | | | | | Most Recent Value | ND | ND | 2 | ND | ND | ND | 4.5 |
| | | | | | GWCL Exceedances | 0 | 0 | 3 | 0 | 3 | 2 | 35 |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | 3 | 0 | 6 | 7 | 35 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trichloroethene (TCE) | 3 | 0.11 | 2.4 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | ND | ND | 1.1 | ND | 24.8 | 5.4 | 6.4 |
| | | | | | Min Value | ND | ND | 1 | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | 1.1 | ND | ND | ND | 1.4 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 3 | 4 | 5 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 3 | 0 | 18 | 14 | 34 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 4 | 4 | 6 |
| cis-1,2-Dichloroethene | | | 80 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 40 | 34 | 35 |
| | | | | | Max Value | 0.031 | 19 | 26 | ND | 75 | 72.21 | 109.36 |
| | | | | | Min Value | ND | 12 | 26 | ND | ND | ND | 19 |
| | | | | | Most Recent Value | ND | 19 | 26 | ND | 3 | 1.6 | 20 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| trans-1,2-Dichloroethene | | | 160 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 35 | 34 |
| | | | | | Max Value | ND | ND | ND | ND | 223 | 16 | 0.8 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | 1 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Vinyl Chloride | 0.02 | 0.029 | 24 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | ND | 61 | 29 | ND | 680 | 150 | 70 |
| | | | | | Min Value | ND | 21 | 29 | ND | ND | ND | 17 |
| | | | | | Most Recent Value | ND | 61 | 29 | ND | 6.4 | 2.2 | 32 |
| | | | | | GWCL Exceedances | 0 | 3 | 3 | 0 | 40 | 33 | 35 |
| | | | | | MTCA-B carcin Exceedances | 0 | 3 | 3 | 0 | 40 | 33 | 35 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 2 | 3 | 0 | 20 | 11 | 26 |
| 1,2-Dichloropropane | 0.6 | 0.64 | | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | 1.6 | 1.3 | 21 | ND | 360 | 240 | 42 |
| | | | | | Min Value | ND | ND | 18 | ND | ND | ND | 3.5 |
| | | | | | Most Recent Value | ND | 1.3 | 18 | ND | 5.1 | 4.2 | 5.1 |
| | | | | | GWCL Exceedances | 1 | 2 | 3 | 0 | 39 | 31 | 35 |
| | | | | | MTCA-B carcin Exceedances | 1 | 2 | 3 | 0 | 39 | 31 | 35 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bromodichloromethane | 0.3 | 0.71 | 160 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 39 | 34 | 34 |
| | | | | | Max Value | ND | ND | ND | ND | 7 | 240 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Chloromethane | | 3.4 | | ug/L | Total Samples | 36 | 3 | 3 | 20 | 39 | 34 | 35 |
| | | | | | Max Value | ND | ND | ND | ND | 35 | 31 | 32 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 5 | 3 | 3 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dichloromethane (Methylene Chloride) | 5 | 5.8 | 480 | ug/l | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | ND | ND | ND | ND | 24 | 230 | 21 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | 18 | 6.8 | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 7 | 8 | 2 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 7 | 8 | 2 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chloroform | 7 | 7.2 | 80 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 39 | 34 | 34 |
| | | | | | Max Value | ND | ND | ND | 0.22 | 5 | 20 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-Butanone | | | 4800 | ug/L | Total Samples | 31 | 3 | 3 | 19 | 32 | 28 | 29 |
| | | | | | Max Value | 0.79 | ND | ND | ND | 9800 | 2200 | 1.3 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | ROZA WELLS Atkins Old | EW-1 "Hole" | EW-2 | MW-19b | MW-3b | MW-7b | MW-9b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-Methyl-2-Pentanone (MIBK) | | | 640 | ug/L | Total Samples | 30 | 3 | 3 | 19 | 29 | 28 | 29 |
| | | | | | Max Value | ND | ND | ND | ND | 8100 | 1500 | 0.63 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 4 | 2 | 0 |
| Acetone | | | 800 | ug/L | Total Samples | 31 | 3 | 3 | 19 | 32 | 29 | 30 |
| | | | | | Max Value | 9.6 | 13 | ND | 7 | 16000 | 7300 | 8.6 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | 13 | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 2 | 1 | 0 |
| Benzene | 1 | 0.8 | 24 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 34 | 35 |
| | | | | | Max Value | ND | 2.6 | 2.3 | ND | 43 | 51 | 3.7 |
| | | | | | Min Value | ND | 1.2 | 2 | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | 2.6 | 2 | ND | 20 | 2.7 | 1.9 |
| | | | | | GWCL Exceedances | 0 | 3 | 3 | 0 | 39 | 31 | 26 |
| | | | | | MTCA-B carcin Exceedances | 0 | 3 | 3 | 0 | 39 | 31 | 27 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 5 | 5 | 0 |
| 1,4-Dichlorobenzene | 4 | 1.8 | | ug/L | Total Samples | 36 | 4 | 4 | 20 | 41 | 33 | 34 |
| | | | | | Max Value | ND | 1.3 | 1 | ND | 8 | 15 | 1.9 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | 6.8 | 3.1 | 1.9 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 8 | 8 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 15 | 13 | 2 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ethylbenzene | | | 800 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 39 | 34 | 35 |
| | | | | | Max Value | ND | ND | ND | 9.7 | 830 | 680 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | 9.8 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Toluene | | | 1600 | ug/L | Total Samples | 36 | 3 | 3 | 20 | 41 | 33 | 34 |
| | | | | | Max Value | 0.5 | ND | ND | 0.83 | 17000 | 5200 | 1.1 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 4 | 4 | 0 |
| Bis(2-ethylhexyl) Phthalate | 6 | 6.3 | 320 | ug/L | Total Samples | 6 | 3 | 3 | 4 | 8 | 6 | 7 |
| | | | | | Max Value | 1.8 | ND | ND | 9.3 | 15 | 7.3 | 2 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acrylonitrile | 0.07 | 0.081 | 8 | ug/L | Total Samples | 31 | 3 | 3 | 19 | 31 | 28 | 29 |
| | | | | | Max Value | ND | ND | ND | ND | ND | ND | 0.51 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Metals** | | | | | | | | | | | | |
| Antimony, Dissolved | | | 6.4 | ug/L | Total Samples | 35 | 3 | 3 | 17 | 35 | 32 | 33 |
| | | | | | Max Value | 5.6 | ND | ND | ND | ND | ND | 9.6 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Arsenic, Dissolved | 0.05 | 0.058 | 4.8 | ug/L | Total Samples | 35 | 3 | 3 | 17 | 35 | 32 | 33 |
| | | | | | Max Value | 5.2 | ND | 90 | ND | 6 | 7.2 | 5.9 |
| | | | | | Min Value | ND | ND | 80 | ND | ND | ND | ND |
| | | | | | Most Recent Value | 4 | ND | 80 | ND | 2 | 2 | 3 |
| | | | | | GWCL Exceedances | 29 | 0 | 3 | 0 | 23 | 16 | 24 |
| | | | | | MTCA-B carcin Exceedances | 29 | 0 | 3 | 0 | 23 | 16 | 24 |
| | | | | | MTCA-B non-carcin Exceedances | 1 | 0 | 3 | 0 | 1 | 1 | 1 |
| Barium, Total | 1000 | | 3200 | ug/L | Total Samples | 5 | NM | NM | NM | 7 | 4 | 6 |
| | | | | | Max Value | 6950 | NM | NM | NM | 93600 | 34430 | 29030 |
| | | | | | Min Value | ND | NM | NM | NM | ND | ND | ND |
| | | | | | Most Recent Value | ND | NM | NM | NM | 375 | ND | 200 |
| | | | | | GWCL Exceedances | 2 | NM | NM | NM | 1 | 1 | 1 |
| | | | | | MTCA-B carcin Exceedances | 0 | NM | NM | NM | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 1 | NM | NM | NM | 1 | 1 | 1 |

| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | ROZA WELLS Atkins Old | EW-1 "Hole" | EW-2 | MW-19b | MW-3b | MW-7b | MW-9b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium, Dissolved | | | 8 | ug/L | Total Samples | 34 | 3 | 3 | 17 | 35 | 32 | 33 |
| | | | | | Max Value | 35 | ND | ND | ND | 0.3 | 0.3 | 8 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron, Dissolved | 300 | | | ug/L | Total Samples | 3 | NM | NM | NM | 4 | 3 | 3 |
| | | | | | Max Value | 80 | NM | NM | NM | 5770 | 1690 | 610 |
| | | | | | Min Value | ND | NM | NM | NM | 1970 | 8 | 0 |
| | | | | | Most Recent Value | ND | NM | NM | NM | 5770 | 1690 | 0 |
| | | | | | GWCL Exceedances | 0 | NM | NM | NM | 4 | 1 | 1 |
| | | | | | MTCA-B carcin Exceedances | 0 | NM | NM | NM | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | NM | NM | NM | 0 | 0 | 0 |
| Iron, Total | 300 | | | ug/L | Total Samples | 37 | 3 | 3 | 19 | 41 | 34 | 38 |
| | | | | | Max Value | 210 | 16400 | 100 | 2790 | 8600 | 3200 | 1030 |
| | | | | | Min Value | ND | 13700 | 90 | 50 | ND | ND | ND |
| | | | | | Most Recent Value | ND | 16400 | 90 | 380 | 3920 | 950 | ND |
| | | | | | GWCL Exceedances | 0 | 3 | 0 | 13 | 35 | 30 | 2 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Manganese, Dissolved | 50 | | 2200 | ug/L | Total Samples | 3 | NM | NM | NM | 4 | 2 | 2 |
| | | | | | Max Value | 11 | NM | NM | NM | 14700 | 13500 | 6490 |
| | | | | | Min Value | 2.2 | NM | NM | NM | 800 | 9900 | 4780 |
| | | | | | Most Recent Value | 2.2 | NM | NM | NM | 14700 | 13500 | 6490 |
| | | | | | GWCL Exceedances | 0 | NM | NM | NM | 4 | 2 | 2 |
| | | | | | MTCA-B carcin Exceedances | 0 | NM | NM | NM | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | NM | NM | NM | 3 | 2 | 2 |
| Manganese, Total | 50 | | 2200 | ug/L | Total Samples | 37 | 3 | 3 | 19 | 40 | 34 | 38 |
| | | | | | Max Value | 4240 | 23000 | 9470 | 1360 | 21400 | 17700 | 270000 |
| | | | | | Min Value | ND | 21400 | 8660 | 86 | 13.3 | ND | ND |
| | | | | | Most Recent Value | ND | 23000 | 8660 | 1360 | 8850 | 6300 | 8580 |
| | | | | | GWCL Exceedances | 1 | 3 | 3 | 19 | 39 | 33 | 35 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 1 | 3 | 3 | 0 | 39 | 30 | 32 |
| Selenium, Dissolved | 10 | | 80 | ug/L | Total Samples | 35 | 3 | 3 | 17 | 35 | 32 | 33 |
| | | | | | Max Value | ND | ND | ND | 3 | 6 | ND | 15.3 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NOTES:
Shaded results indicate where an exceedance of either GWCL or MTCA-B groundwater standards have occurred at least once
ND = No Detection above limit
NM = Not Measured
MTCA-B Car = Model Toxic Control Act Method B Carcinogenic
MTCA-B Non Car = Model Toxic Control Act Method B Non Carcinogenic
GWCL = State Groundwater Contaminant Levels (WAC 173-200)
EW-1 and EW-2 were sampled three times during a single pump test 2001

**TABLE 2: Summary of Constituents Exceeding Groundwater Contaminant Levels (GWCL) and MTCA Method B in The Interflow Aquifer**
**Grant County Ephrata Landfill (October 1989 through December 2005)**

| | STANDARDS | | | | | INTERFLOW WELLS | | | | | | | BELOW INTERFLOW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONSTITUENT | GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | MW-20c | MW-21c | MW-22c | MW-2c | MW-4c | MW-5c | MW-6c | MW-16d |
| **Inorganics** | | | | | | | | | | | | | |
| Chloride | 250 | | | mg/L | Total Samples | 23 | 23 | 19 | 52 | 53 | 53 | 52 | 17 |
| | | | | | Max Value | 16 | 28 | 88.8 | 540 | 229.93 | 427 | 187.94 | 140 |
| | | | | | Min Value | 2.8 | 5.2 | 44 | 1.2 | 7.2 | 1.8 | 7.1 | 6.5 |
| | | | | | Most Recent Value | 4 | 5.2 | 88.8 | 469 | 8.9 | 371 | 11.8 | 54.6 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 29 | 0 | 14 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrate as Nitrogen | 10 | | | mg/L as N | Total Samples | 19 | 19 | 17 | 36 | 37 | 37 | 36 | 17 |
| | | | | | Max Value | 1.14 | 81.1 | 8.29 | 11.4 | 10.3 | 12.2 | 6.05 | 0.034 |
| | | | | | Min Value | 0.2 | 21 | 6.8 | ND | ND | 0.03 | 0.05 | ND |
| | | | | | Most Recent Value | 1.14 | 81.1 | 8.29 | 9.46 | ND | 9.55 | 4.87 | ND |
| | | | | | GWCL Exceedances | 0 | 19 | 0 | 9 | 1 | 5 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrate+Nitrite as Nitrogen | 10 | | | mg/L as N | Total Samples | 23 | 23 | 19 | 36 | 36 | 37 | 36 | 17 |
| | | | | | Max Value | 1.2 | 81.1 | 8.32 | 12.1 | 0.1 | 12 | 6.07 | 0.034 |
| | | | | | Min Value | 0.2 | 2.23 | 6.8 | 4 | ND | 3.55 | 0.98 | ND |
| | | | | | Most Recent Value | 1.14 | 81.1 | 8.32 | 9.46 | 0.01 | 9.59 | 4.89 | 0.01 |
| | | | | | GWCL Exceedances | 0 | 21 | 0 | 19 | 0 | 3 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrite as Nitrogen | 10 | | | mg/L as N | Total Samples | 19 | 19 | 17 | 36 | 37 | 37 | 36 | 17 |
| | | | | | Max Value | 0.19 | 1 | 0.032 | 20.19 | 0.324 | 29.7 | 0.283 | 0.011 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | 0.031 | ND | ND | 0.039 | 0.022 | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sulfate | 250 | | | mg/L | Total Samples | 23 | 23 | 19 | 53 | 54 | 54 | 53 | 17 |
| | | | | | Max Value | 33.9 | 74.4 | 48.5 | 147 | 92.6 | 353 | 108 | 67.8 |
| | | | | | Min Value | 20.1 | 28.3 | 34 | ND | 0.717 | 1.65 | 0.901 | 3.4 |
| | | | | | Most Recent Value | 29.9 | 68.8 | 39.5 | 57.4 | 32.4 | 148 | 37.9 | 67.8 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Dissolved Solids | 500 | | | mg/L | Total Samples | 23 | 23 | 19 | 35 | 35 | 36 | 35 | 17 |
| | | | | | Max Value | 342 | 1080 | 522 | 1870 | 352 | 14000 | 618 | 840 |
| | | | | | Min Value | 204 | 240 | 332 | 480 | 180 | 388 | 250 | 330 |
| | | | | | Most Recent Value | 216 | 614 | 332 | 1020 | 200 | 1010 | 315 | 357 |
| | | | | | GWCL Exceedances | 0 | 10 | 1 | 34 | 0 | 35 | 2 | 2 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Organics** | | | | | | | | | | | | | |
| 1,1-Dichloroethane | 1 | | 800 | ug/L | Total Samples | 23 | 23 | 19 | 46 | 38 | 45 | 37 | 19 |
| | | | | | Max Value | ND | ND | 5 | 3.2 | ND | 2 | 3.9 | 0.24 |
| | | | | | Min Value | ND | ND | 3.5 | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | 3.9 | 1.7 | ND | 1.3 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 19 | 31 | 0 | 25 | 4 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,2-Dibromoethane | 0.001 | 0.00051 | | ug/L | Total Samples | 4 | 4 | NM | 17 | 16 | 17 | 16 | 2 |
| | | | | | Max Value | ND | ND | NM | ND | ND | 0.2 | ND | ND |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | NM | ND | ND | 0.039 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 5 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | NM | 0 | 0 | 5 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | 0 |
| 1,2-Dichloroethane (EDC) | 0.5 | 0.48 | 160 | ug/L | Total Samples | 23 | 23 | 19 | 46 | 38 | 45 | 37 | 19 |
| | | | | | Max Value | ND | ND | ND | 0.5 | ND | 1.7 | 0.77 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | 1.1 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 37 | 1 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 1 | 0 | 38 | 1 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,1-Dichloroethene | | 0.073 | 40 | ug/L | Total Samples | 23 | 23 | 19 | 46 | 38 | 45 | 37 | 19 |
| | | | | | Max Value | ND | ND | 1.2 | 0.14 | ND | 0.8 | 0.88 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 6 | 6 | 0 | 3 | 2 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | INTERFLOW WELLS MW-20c | MW-21c | MW-22c | MW-2c | MW-4c | MW-5c | MW-6c | BELOW INTERFLOW MW-16d |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tetrachloroethene (PCE) | 0.8 | 0.081 | 80 | ug/L | Total Samples | 23 | 23 | 19 | 46 | 38 | 45 | 37 | 19 |
| | | | | | Max Value | ND | ND | 5.3 | 6.7 | 0.044 | 11 | 1.6 | 0.081 |
| | | | | | Min Value | ND | ND | 3.4 | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | 4.4 | 1.4 | ND | 9.2 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 19 | 43 | 0 | 44 | 7 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 19 | 44 | 0 | 44 | 14 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trichloroethene (TCE) | 3 | 0.11 | 2.4 | ug/L | Total Samples | 23 | 23 | 19 | 46 | 38 | 45 | 37 | 19 |
| | | | | | Max Value | ND | ND | 2.9 | 0.82 | ND | 1.9 | 0.83 | 0.097 |
| | | | | | Min Value | ND | ND | 1.5 | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | 1.5 | ND | ND | 1.4 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 19 | 9 | 0 | 38 | 4 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Chloromethane | | 3.4 | | ug/L | Total Samples | 23 | 23 | 19 | 45 | 37 | 44 | 37 | 19 |
| | | | | | Max Value | ND | ND | ND | ND | 5.36 | 0.6 | 5.36 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,2-Dichloropropane | 0.6 | 0.64 | | ug/L | Total Samples | 23 | 23 | 19 | 46 | 38 | 45 | 37 | 19 |
| | | | | | Max Value | ND | ND | ND | 0.68 | 0.75 | 2 | 0.64 | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | 1.2 | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 3 | 1 | 40 | 1 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 3 | 1 | 40 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carbon Tetrachloride | 0.3 | 0.34 | 5.6 | ug/L | Total Samples | 23 | 23 | 19 | 45 | 37 | 44 | 37 | 19 |
| | | | | | Max Value | ND | ND | ND | ND | ND | 0.39 | ND | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chrysene | | 0.012 | | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 0.27 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 0.27 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| Pentachlorophenol | | 0.73 | 480 | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 1.1 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 1.1 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| Bis(2-ethylhexyl) Phthalate | 6 | 6.3 | 320 | ug/L | Total Samples | 9 | 9 | 14 | 8 | 7 | 8 | 7 | 12 |
| | | | | | Max Value | 2.6 | ND | 2 | ND | ND | 30 | 3.7 | 8.1 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | 2.6 | ND | ND | ND | ND | 1.8 | 3.7 | 2.2 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Benz(a)anthracene | | 0.012 | | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 0.24 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 0.24 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| Benzo(A)Pyrene | 0.008 | 0.012 | | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 0.18 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 0.18 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| Benzo(B)Fluoranthene | | 0.012 | | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 0.38 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 0.38 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |

| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | INTERFLOW WELLS MW-20c | MW-21c | MW-22c | MW-2c | MW-4c | MW-5c | MW-6c | BELOW INTERFLOW MW-16d |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(K)Fluoranthene | | 0.012 | | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 0.21 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 0.21 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| Dibenz(A,H)Anthracene | | 0.012 | | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 0.14 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 0.14 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| Indeno(1,2,3-CD)Pyrene | | 0.012 | | ug/L | Total Samples | 2 | 2 | NM | 3 | 2 | 3 | 2 | NM |
| | | | | | Max Value | 0.33 | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Min Value | ND | ND | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | 0.33 | 0 | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B carcin Exceedances | 1 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | NM | 0 | 0 | 0 | 0 | NM |
| **Metals** | | | | | | | | | | | | | |
| Arsenic, Dissolved | 0.05 | 0.058 | 4.8 | ug/L | Total Samples | 23 | 23 | 18 | 37 | 36 | 37 | 36 | 17 |
| | | | | | Max Value | 2 | 2 | 2 | 4 | 1 | 4 | 5 | 2 |
| | | | | | Min Value | ND | ND | 1 | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | 2 | 2 | 2 | ND | ND | 2 | 5 | 2 |
| | | | | | GWCL Exceedances | 17 | 14 | 18 | 6 | 1 | 16 | 27 | 14 |
| | | | | | MTCA-B carcin Exceedances | 17 | 14 | 18 | 6 | 1 | 16 | 27 | 14 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| Barium, Total | 1000 | | 3200 | ug/L | Total Samples | NM | NM | NM | 12 | 13 | 12 | 13 | NM |
| | | | | | Max Value | NM | NM | NM | 130000 | 50700 | 90000 | 10720 | NM |
| | | | | | Min Value | NM | NM | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | NM | NM | NM | ND | ND | ND | ND | NM |
| | | | | | GWCL Exceedances | NM | NM | NM | 3 | 1 | 2 | 1 | NM |
| | | | | | MTCA-B carcin Exceedances | NM | NM | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | NM | NM | NM | 3 | 1 | 2 | 1 | NM |
| Iron, Dissolved | 300 | | | ug/L | Total Samples | NM | NM | NM | 7 | 7 | 7 | 6 | NM |
| | | | | | Max Value | NM | NM | NM | 150 | 110 | 90 | 606 | NM |
| | | | | | Min Value | NM | NM | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | NM | NM | NM | 35.1 | 13.5 | ND | 606 | NM |
| | | | | | GWCL Exceedances | NM | NM | NM | 0 | 0 | 0 | 1 | NM |
| | | | | | MTCA-B carcin Exceedances | NM | NM | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | NM | NM | NM | 0 | 0 | 0 | 0 | NM |
| Iron, Total | 300 | | | ug/L | Total Samples | 23 | 23 | 19 | 46 | 47 | 47 | 47 | 16 |
| | | | | | Max Value | 606 | 140 | 210 | 111 | 290 | 126 | 236 | 12900 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | 990 |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | 3280 |
| | | | | | GWCL Exceedances | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Manganese, Dissolved | 50 | | 2200 | ug/L | Total Samples | NM | NM | NM | 6 | 6 | 6 | 6 | NM |
| | | | | | Max Value | NM | NM | NM | 160 | 39 | 10 | 52 | NM |
| | | | | | Min Value | NM | NM | NM | ND | ND | ND | ND | NM |
| | | | | | Most Recent Value | NM | NM | NM | ND | 27.6 | ND | 2.4 | NM |
| | | | | | GWCL Exceedances | NM | NM | NM | 1 | 0 | 0 | 1 | NM |
| | | | | | MTCA-B carcin Exceedances | NM | NM | NM | 0 | 0 | 0 | 0 | NM |
| | | | | | MTCA-B non-carcin Exceedances | NM | NM | NM | 0 | 0 | 0 | 0 | NM |
| Manganese, Total | 50 | | 2200 | ug/L | Total Samples | 23 | 23 | 19 | 46 | 47 | 47 | 47 | 16 |
| | | | | | Max Value | 28.5 | 948 | 24 | 27730 | 10980 | 24830 | 20280 | 1280 |
| | | | | | Min Value | ND | 40.4 | ND | ND | ND | ND | ND | 151 |
| | | | | | Most Recent Value | ND | 215 | 5 | ND | 28 | ND | ND | 173 |
| | | | | | GWCL Exceedances | 0 | 22 | 0 | 3 | 1 | 2 | 2 | 16 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 3 | 1 | 2 | 1 | 0 |

NOTES:
Shaded results indicate where an exceedance of either GWCL or MTCA-B groundwater standards have occurred at least once
ND = No Detection above limit
NM = Not Measured
MTCA-B Car = Model Toxic Control Act Method B Carcinogenic
MTCA-B Non Car = Model Toxic Control Act Method B Non Carcinogenic
GWCL = State Groundwater Contaminant Levels (WAC 173-200)

## TABLE 3: Summary of Constituents Exceeding Groundwater Contaminant Levels (GWCL) and MTCA Method B in The Outwash Aquifer

**Grant County Ephrata Landfill (October 1989 through December 2005)**

| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | OUTWASH WELLS MW-10a | MW-11a | MW-14a | MW-17a | MW-18a | MW-1a | MW-23a | MW-6a |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | | | | | | | | |
| Chloride | 250 | | | mg/L | Total Samples | 19 | 18 | 21 | 5 | 4 | 21 | 19 | 20 |
| | | | | | Max Value | 14.8 | 31.7 | 16.1 | 18.6 | 31 | 15 | 13.9 | 638 |
| | | | | | Min Value | 3 | 10.4 | 12.8 | 11.8 | 27 | 6.5 | 7.7 | 13 |
| | | | | | Most Recent Value | 13.9 | 10.4 | 12.8 | 11.8 | 31 | 8.6 | 13.9 | 550 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrate as Nitrogen | 10 | | | mg/L as N | Total Samples | 17 | 15 | 19 | 3 | 2 | 19 | 17 | 16 |
| | | | | | Max Value | 5.47 | 6.3 | 3.3 | 4.4 | 2.5 | 4.86 | 5.39 | 11.2 |
| | | | | | Min Value | 2.8 | 4.2 | 1.8 | 2.71 | 1.7 | 2.5 | 3.3 | 3.336 |
| | | | | | Most Recent Value | 5.47 | 5.24 | 3.04 | 3.48 | 2.5 | 3.69 | 5.12 | 9.78 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrate+Nitrite as Nitrogen | 10 | | | mg/L as N | Total Samples | 19 | 18 | 21 | 6 | 4 | 22 | 19 | 19 |
| | | | | | Max Value | 5.49 | 6.33 | 5.29 | 7.15 | 2.5 | 4.88 | 5.41 | 11.2 |
| | | | | | Min Value | 0.54 | 2.97 | 1.8 | 2.72 | 1.66 | 2.5 | 3.3 | 3.44 |
| | | | | | Most Recent Value | 5.49 | 5.26 | 3.05 | 3.5 | 2.5 | 3.71 | 5.14 | 9.82 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Dissolved Solids | 500 | | | mg/L | Total Samples | 19 | 18 | 21 | 5 | 4 | 21 | 19 | 19 |
| | | | | | Max Value | 362 | 432 | 393 | 374 | 374 | 330 | 853 | 2400 |
| | | | | | Min Value | 204 | 280 | 320 | 310 | 270 | 173 | 260 | 348 |
| | | | | | Most Recent Value | 336 | 358 | 345 | 352 | 340 | 173 | 282 | 1630 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 14 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Organics** | | | | | | | | | | | | | |
| 1,1-Dichloroethane | 1 | | 800 | ug/L | Total Samples | 19 | 18 | 21 | 6 | 3 | 21 | 19 | 20 |
| | | | | | Max Value | 0.046 | ND | 0.52 | 0.52 | 1.6 | ND | ND | 5.3 |
| | | | | | Min Value | ND | ND | ND | ND | 1.3 | ND | ND | 0 |
| | | | | | Most Recent Value | ND | ND | ND | ND | 1.3 | ND | ND | 2.6 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 19 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,1-Dichloroethene | | 0.073 | 40 | ug/L | Total Samples | 19 | 18 | 21 | 6 | 3 | 21 | 19 | 20 |
| | | | | | Max Value | ND | ND | ND | ND | ND | ND | ND | 0.47 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tetrachloroethene (PCE) | 0.8 | 0.081 | 80 | ug/L | Total Samples | 19 | 18 | 21 | 6 | 3 | 21 | 19 | 20 |
| | | | | | Max Value | 0.12 | 0.56 | 0.48 | ND | 0.057 | ND | ND | 1.8 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | 1.2 |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| | | | | | MTCA-B carcin Exceedances | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 19 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trichloroethene (TCE) | 3 | 0.11 | 2.4 | ug/L | Total Samples | 19 | 18 | 21 | 6 | 3 | 21 | 19 | 20 |
| | | | | | Max Value | 0.051 | ND | 0.51 | ND | 0.061 | ND | ND | 1 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 5 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

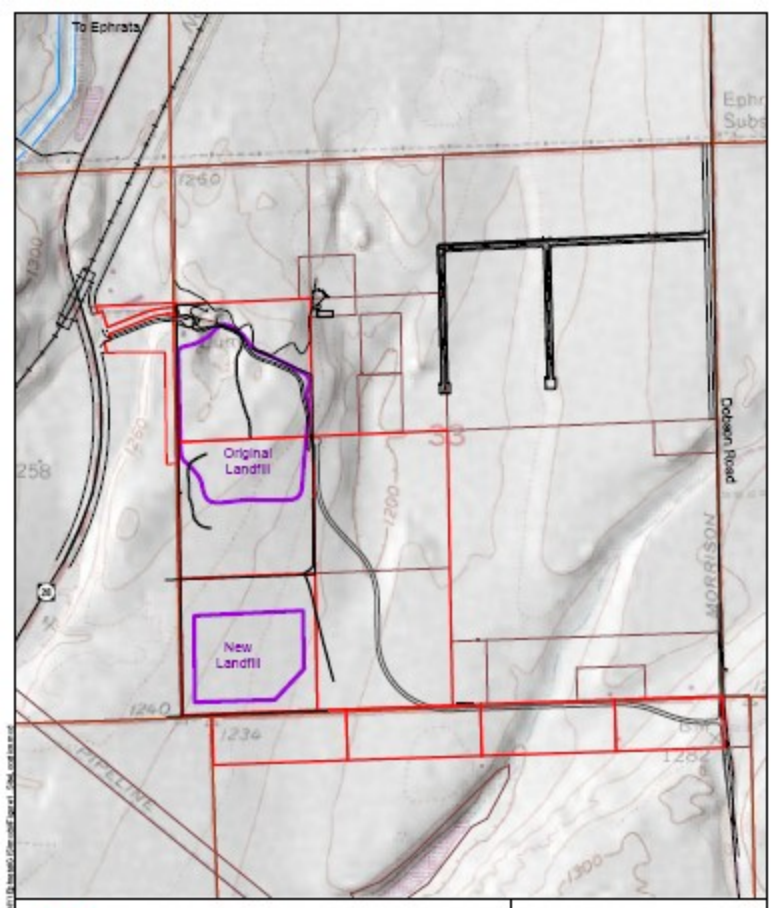
| CONSTITUENT | STANDARDS GWCL | MTCA-B Carcin | MTCA-B Noncarcin | Units | Summary | OUTWASH WELLS MW-10a | MW-11a | MW-14a | MW-17a | MW-18a | MW-1a | MW-23a | MW-6a |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bis(2-ethylhexyl) Phthalate | 6 | 6.3 | 320 | ug/L | Total Samples | 14 | 13 | 16 | 3 | 2 | 15 | 14 | 14 |
| | | | | | Max Value | 2 | 1 | 6.3 | ND | ND | 8.9 | 3 | 5.4 |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | 1.1 | ND | ND | 2.3 | 2.4 | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Metals** | | | | | | | | | | | | | |
| Arsenic, Dissolved | 0.05 | 0.058 | 4.8 | ug/L | Total Samples | 19 | 18 | 21 | 5 | 3 | 21 | 18 | 19 |
| | | | | | Max Value | 6 | 8 | 5.6 | 6 | 4.5 | 4 | 5 | 2 |
| | | | | | Min Value | 3.4 | 3.6 | 3 | 5 | ND | ND | 2 | ND |
| | | | | | Most Recent Value | 6 | 8 | 4 | 6 | 3 | 3 | 5 | 2 |
| | | | | | GWCL Exceedances | 19 | 18 | 21 | 5 | 2 | 18 | 18 | 14 |
| | | | | | MTCA-B carcin Exceedances | 19 | 18 | 21 | 5 | 2 | 18 | 18 | 14 |
| | | | | | MTCA-B non-carcin Exceedances | 15 | 17 | 1 | 5 | 0 | 0 | 5 | 0 |
| Iron, Total | 300 | | | ug/L | Total Samples | 18 | 17 | 20 | 5 | 4 | 21 | 19 | 18 |
| | | | | | Max Value | 90 | 582 | 46600 | 75.2 | 386 | 90 | 270 | 130 |
| | | | | | Min Value | ND | ND | ND | ND | 0.15 | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | 210 | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 1 | 3 | 0 | 1 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Manganese, Total | 50 | | 2200 | ug/L | Total Samples | 18 | 17 | 20 | 5 | 4 | 21 | 19 | 18 |
| | | | | | Max Value | 2 | 27.7 | 1230 | 50.2 | 380 | ND | 11 | 19 |
| | | | | | Min Value | ND | ND | ND | ND | 0.049 | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | 42 | ND | ND | 19 |
| | | | | | GWCL Exceedances | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Thallium, Dissolved | | | 1.1 | ug/L | Total Samples | 19 | 18 | 21 | 5 | 3 | 21 | 18 | 19 |
| | | | | | Max Value | 2 | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Min Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | Most Recent Value | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | GWCL Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B carcin Exceedances | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | MTCA-B non-carcin Exceedances | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NOTES:
Shaded results indicate where an exceedance of either GWCL or MTCA-B groundwater standards have occurred at least once
ND = No Detection above limit
NM = Not Measured
MTCA-B Car = Model Toxic Control Act Method B Carcinogenic
MTCA-B Non Car = Model Toxic Control Act Method B Non Carcinogenic
GWCL = State Groundwater Contaminant Levels (WAC 173-200)

## TABLE 4: Preliminary Contaminants of Concern

| Inorganics | Organics | Metals |
|---|---|---|
| Chloride | 1,2-Dichloroethane (EDC) | Arsenic |
| Sulfate | 1,1-Dichloroethane | Iron |
| Total Dissolved Solids (TDS) | Chloroethane | Manganese |
| Nitrate | | |
| | Tetrachloroethene (PCE) | |
| | Trichloroethene (TCE) | |
| | 1,1-Dichloroethene | |
| | cis-1,2-Dichloroethene | |
| | trans-1,2-Dichloroethene | |
| | Vinyl Chloride | |
| | Chloromethane | |
| | Dichloromethane (Methylene Chloride) | |
| | Trichlorofluoromethane | |
| | 1,2-Dichloropropane | |
| | Benzene | |
| | Toluene | |
| | Ethylbenzene | |
| | Xylene (m, p, o) | |
| | 1,2-Dichlorobenzene | |
| | 1,4-Dichlorobenzene | |
| | Bis(2-ethylhexyl) Phthalate | |

NOTE:
COC organic and inorganic parameters were those that exceeded MTCA-B clean up levels most recently except 1,1-dichloroethene; chloromethane; and toluene which have exceeded MTCA-B levels at least 5 times in the past or were considered important parameters for undertanding fate and transport.



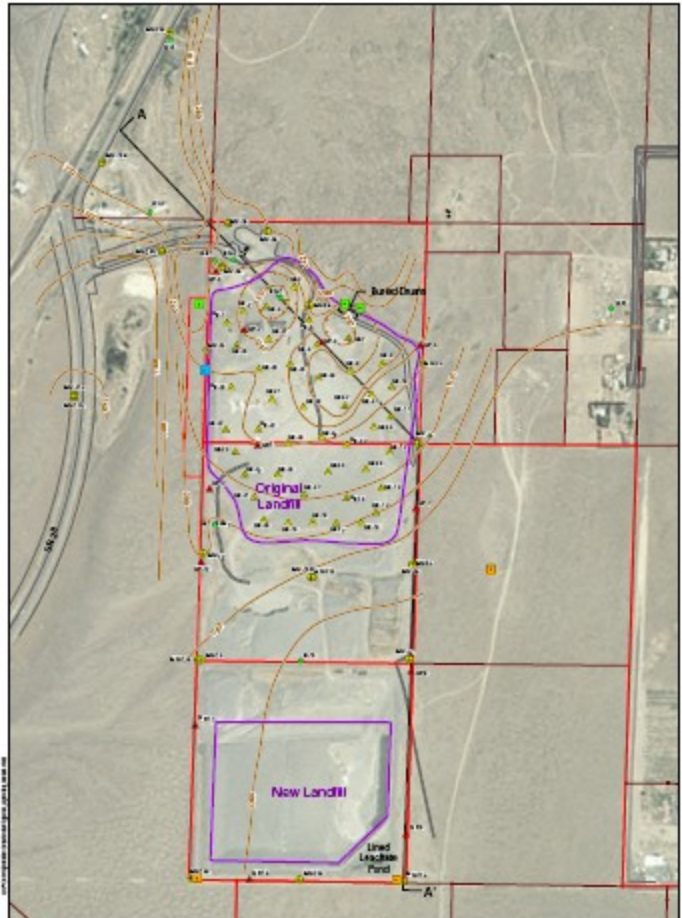

Landfill Parcels
Landfill Extents

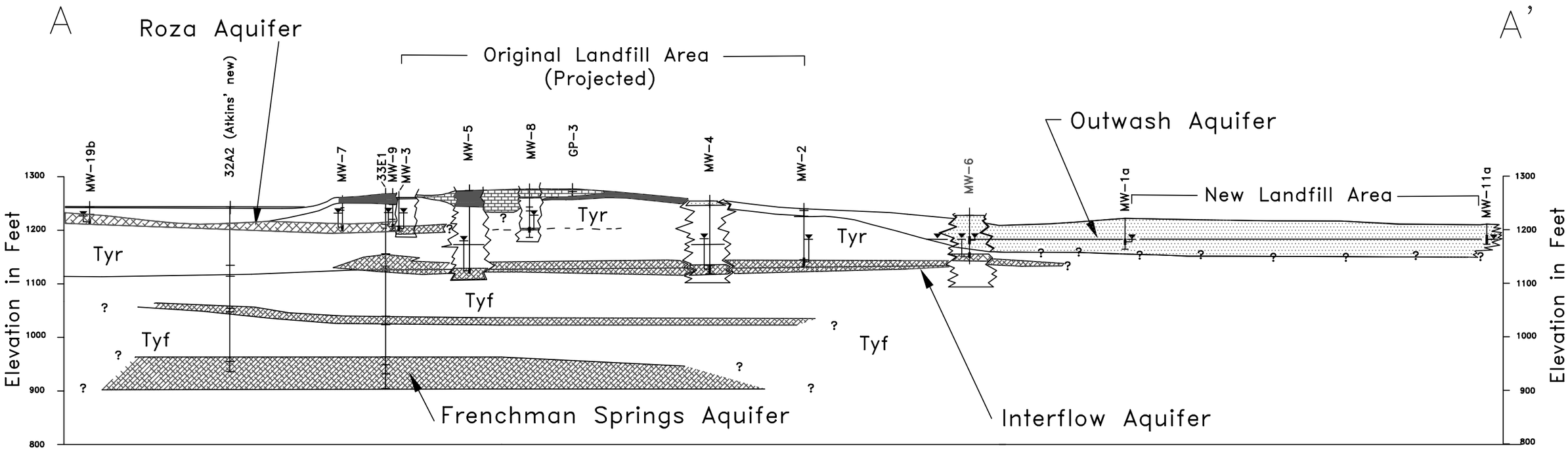
N
0 Feet 1,000

Figure 1
Site Location

RI/FS Work Plan
Ephrata Landfill Corrective Action

PgG


A
A'
Buried Drums
Original Landfill
New Landfill
Lined Leachate Pond
Well Type
Monitoring Well (MW)
Gas Extraction (GE)
Gas Probe (GP)
Other Well
County Owned Parcels
Cross-Section Alignment
Proposed Monitoring Wells
Frenchman Springs Aquifer Well
Interflow Aquifer Well
Ross Aquifer Well
Landfill Extents
Basalt Elevation Contours (December 2005)
10-foot Contour
5-foot Contour
10-foot Depression Contour
5-foot Depression Contour
N
0
Feet
400
Figure 2
Site Plan
PGG




## Legend

- Outwash Gravel and Sand
- Basalt Aquifers
- Original Landfill Refuse
- Well Projected onto Section
- Water Level in Well

Tyf — Basalt – Frenchman Springs Member

Tyr — Basalt – Roza Member

0 100 200 400 800

Horizontal Scale in Feet
Vertical Exaggeration 2X

FIGURE 3

CROSS SECTION A–A'

RI/FS Work Plan
Ephrata Landfill Corrective Action

PgG

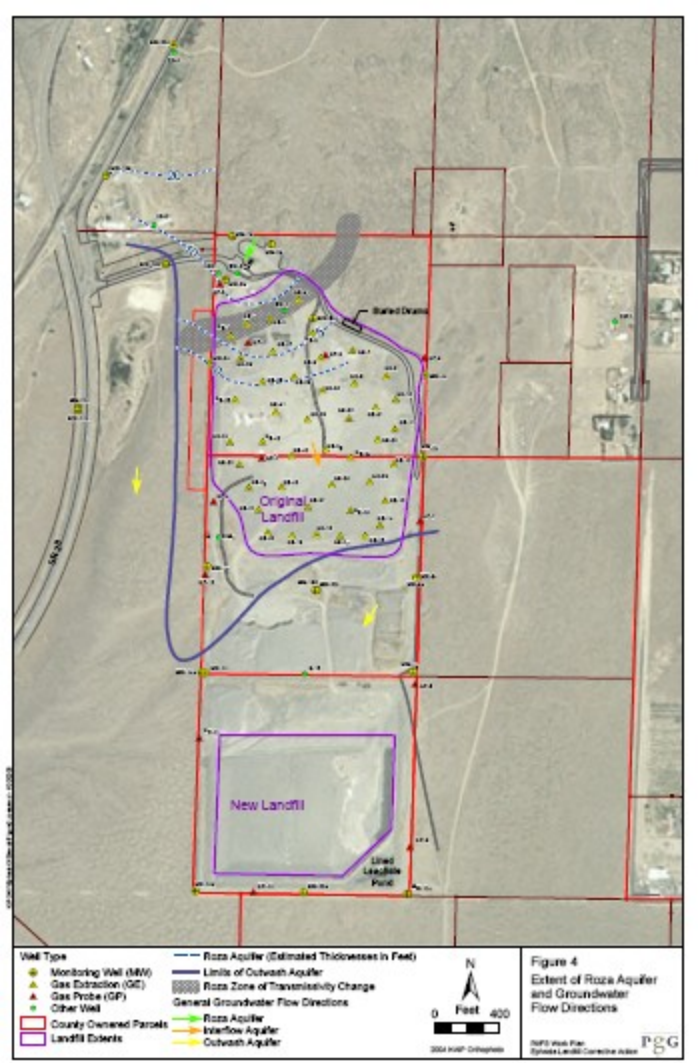
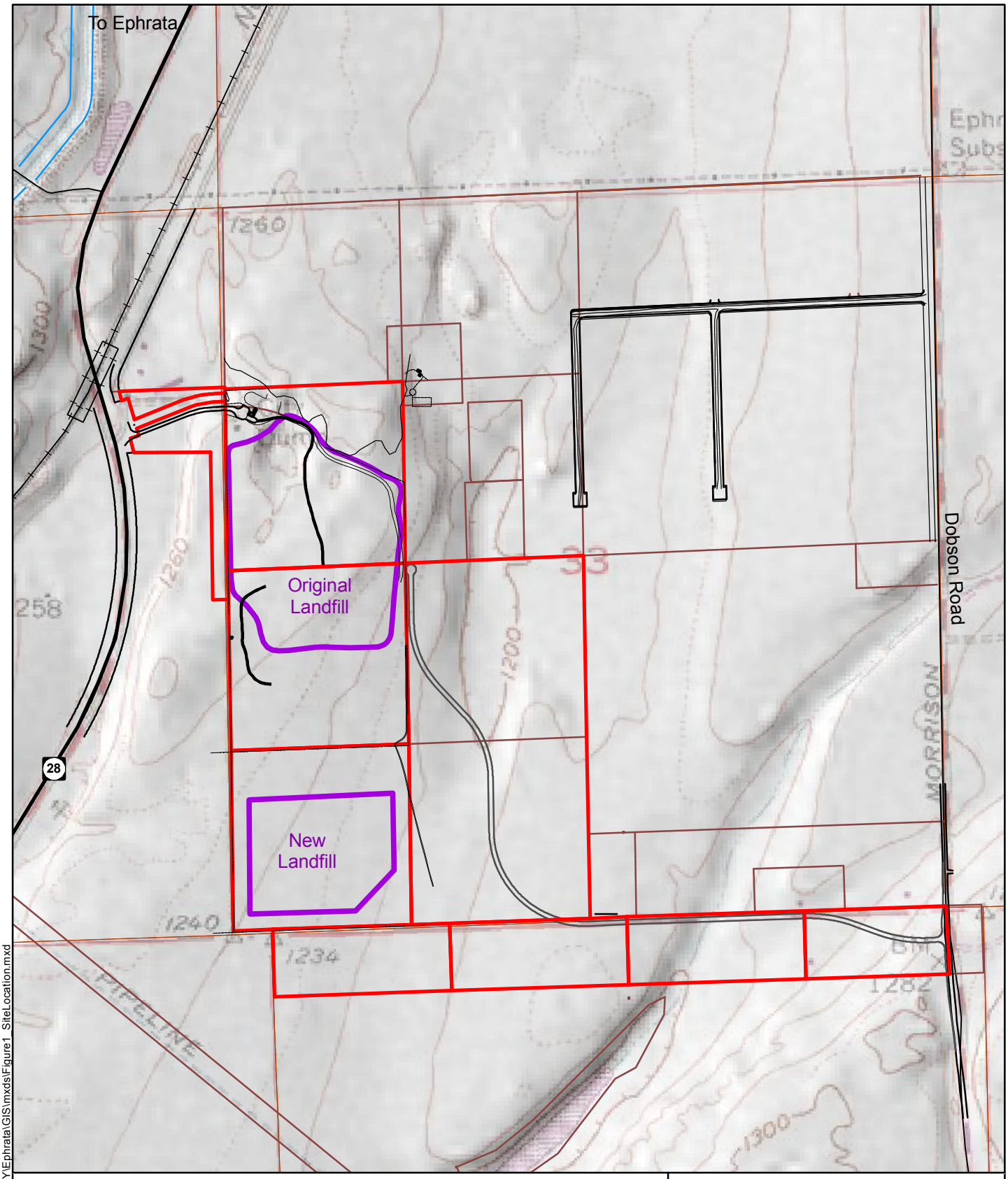



Figure 4
Extent of Roza Aquifer and Groundwater Flow Directions

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Landfill Parcels

Landfill Extents

N

0 Feet 1,000

# Figure 1
# Site Location

RI/FS Work Plan
Ephrata Landfill Corrective Action

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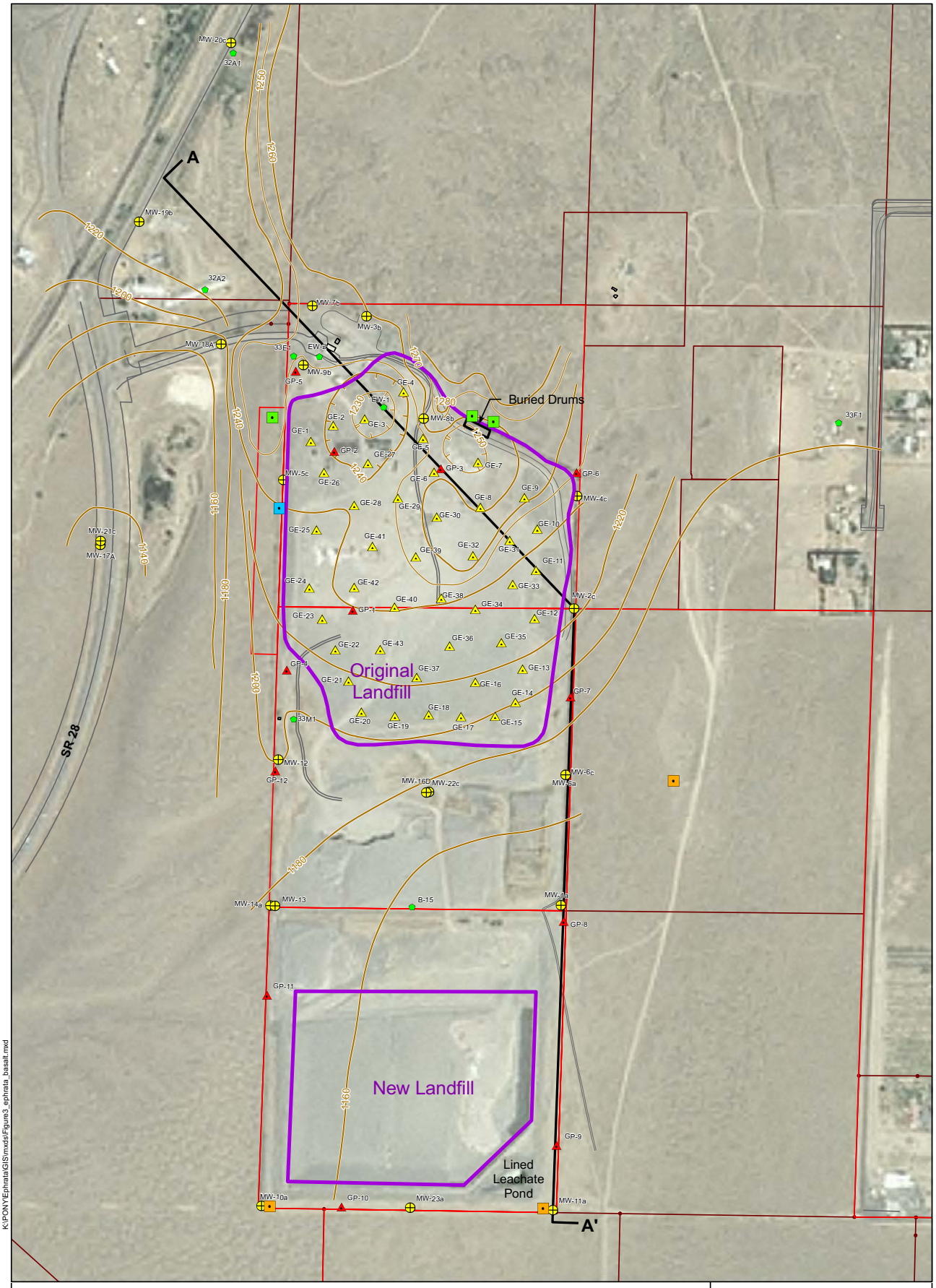


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Well Type
- Monitoring Well (MW)
- Gas Extraction (GE)
- Gas Probe (GP)
- Other Well
- County Owned Parcels
- Cross-Section Allignment

Proposed Monitoring Wells
- Frenchman Springs Aquifer Well
- Interflow Aquifer Well
- Roza Aquifer Well
- Landfill Extents

Basalt Elevation Contours (December 2005)
- 10-foot Contour
- 5-foot Contour
- 10-foot Depression Contour
- 5-foot Depression Contour

N

0 Feet 400

2004 NAIP Orthophoto

Figure 2
Site Plan

RI/FS Work Plan
Ephrata Landfill Corrective Action

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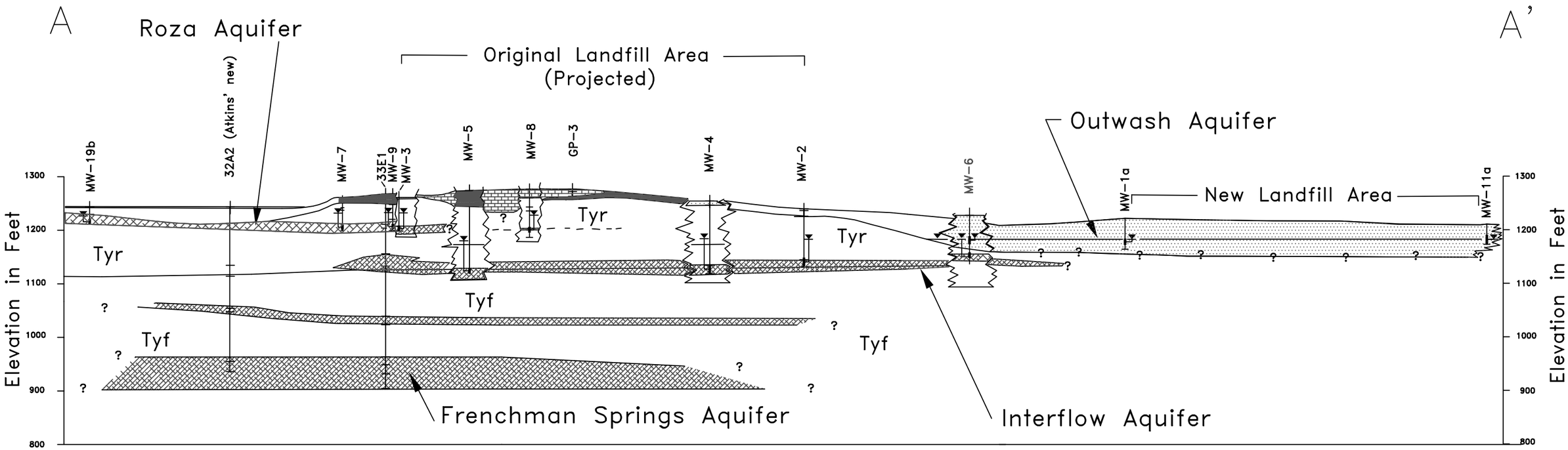


## Legend

- Outwash Gravel and Sand
- Basalt Aquifers
- Original Landfill Refuse
- Well Projected onto Section
- Water Level in Well

Tyf — Basalt – Frenchman Springs Member

Tyr — Basalt – Roza Member

0 100 200 400 800

Horizontal Scale in Feet
Vertical Exaggeration 2X

FIGURE 3

CROSS SECTION A–A'

RI/FS Work Plan
Ephrata Landfill Corrective Action

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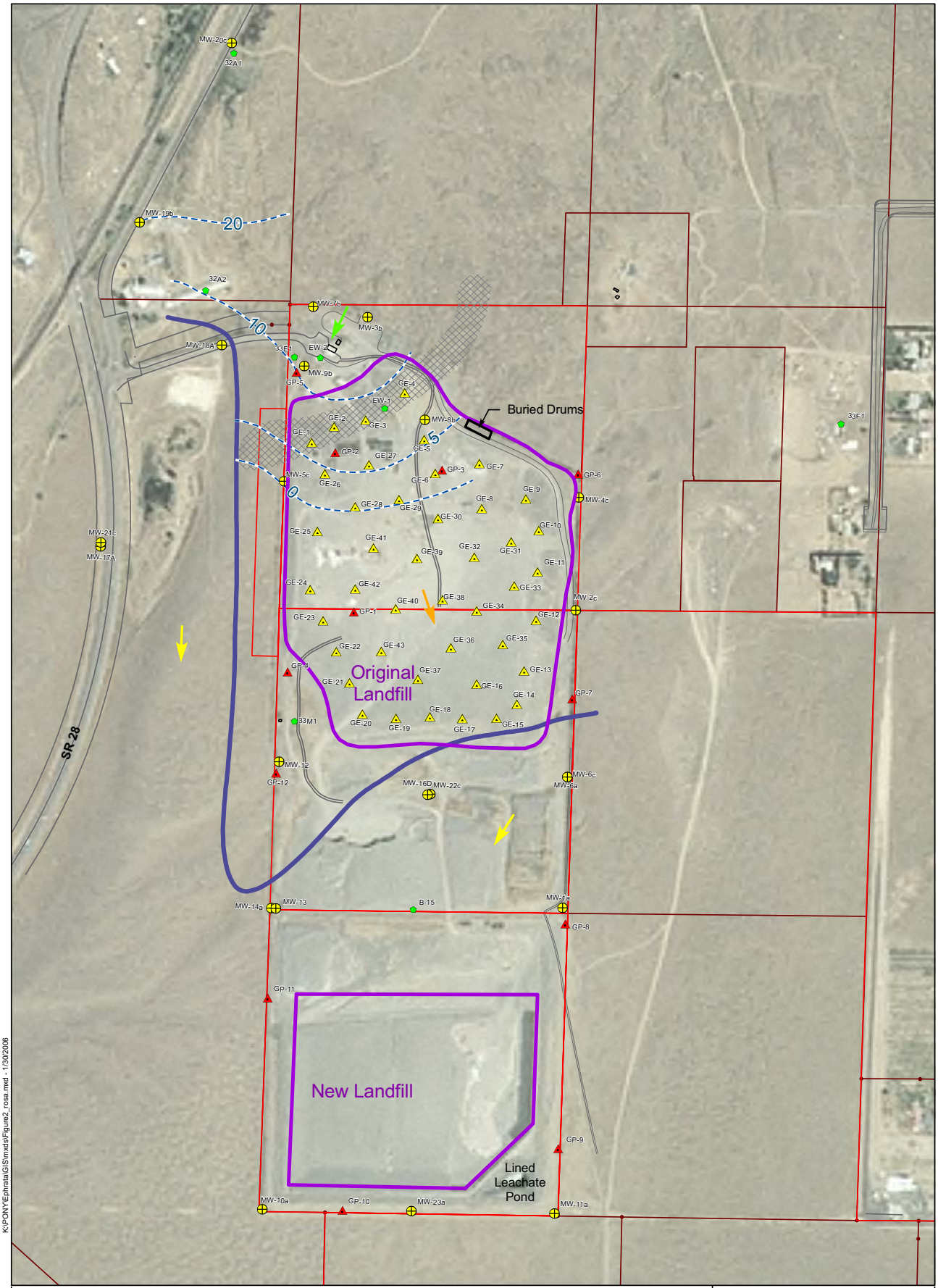


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Well Type
- Monitoring Well (MW)
- Gas Extraction (GE)
- Gas Probe (GP)
- Other Well
- County Owned Parcels
- Landfill Extents

- Roza Aquifer (Estimated Thicknesses in Feet)
- Limits of Outwash Aquifer
- Roza Zone of Transmissivity Change

General Groundwater Flow Directions
- Roza Aquifer
- Interflow Aquifer
- Outwash Aquifer

N

0 Feet 400

2004 NAIP Orthophoto

Figure 4

Extent of Roza Aquifer and Groundwater Flow Directions

RI/FS Work Plan
Ephrata Landfill Corrective Action

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# Interim Remedial Action Plan
# Ephrata Landfill Corrective Action

*Prepared for*

**Grant County Department of Public Works**

and

**City of Ephrata**

*Prepared by*

**Parametrix**
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Bellevue, WA 98004-5571
425-458-6200
www.parametrix.com

*In Association with:*

**Pacific Groundwater Group**
2377 Eastlake Avenue East
Seattle, Washington 98102
206-392-0141
www.pgwg.com

December 2006 | 555-1860-011 (03/05)

# CITATION

Parametrix. 2006. Interim Remedial Action Plan
Ephrata Landfill Corrective Action. Prepared by Parametrix, Bellevue, Washington.
December 2006.

# TABLE OF CONTENTS



## FIGURES INCLUDED FROM THE RI/FS WORKPLAN



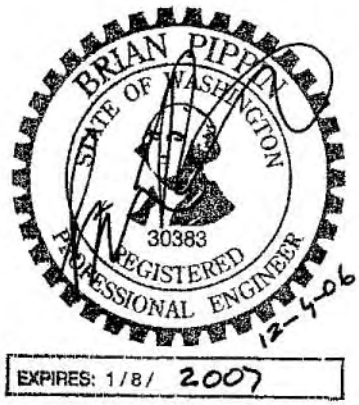
## LIST OF TABLES

# ACRONYMS

| | |
|---|---|
| BTU | British thermal unit |
| CERCLA | Comprehensive Environmental Response, Compensation and Liabilitiy Act |
| CFR | Code of Federal Regulations |
| CQA | Construction Quality Assurance |
| CQC | construction quality control |
| DOT | Department of Transportation |
| Ecology | Washington State Department of Ecology |
| EW | extraction well |
| EW-1 | extraction well |
| gpm | gallon per minute |
| H&SP | health and safety plan |
| HELP3 | Hydrologic Evaluation of Landfill Performance Version 3 |
| mil | one thousanth of an inch |
| O&M | operations and maintenance |
| PS&E | plans, specifications, and estimates |
| PVC | Polyvinyl chloride |
| QAP | quality assurance plan |
| RI/FS | Remedial Investigation/ Feasibility Study |
| SAP | sampling and analysis plan |
| TDS | total dissolved solids |
| VOCs | volatile organic compounds |
| WSDOT | Washington Stae Department of Transportation |

# CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.




Prepared by Brian Pippin, P.E.

Checked by Steve Fuller, L.E.G.

Approved by Dwight E. Miller, P.E.

# 1. INTRODUCTION

## 1.1 REPORT ORGANIZATION

This document is being written and reviewed concurrent with the Final Remedial Investigation/ Feasibility Study (RI/FS) Work Plan, Ephrata Landfill Corrective Action (Pacific Groundwater Group 2006)(hereinafter "RI/FS Work Plan"). The RI/FS Work Plan summarizes the status of the Ephrata Landfill (the site), remedial investigations conducted to date, and describes and evaluates the remedial alternatives to be further developed in the feasibility study. That information is not repeated herein; the content of this document is limited to describing and evaluating the interim actions.

## 1.2 PURPOSE AND OBJECTIVES OF INTERIM ACTIONS

The purpose and objectives of the interim actions are:

- Protection of human health and the environment
- Limiting short-term and long-term remedial action costs
- Ensuring compatibility of interim actions with possible future actions to be identified in the Feasibility Study.

The remedial investigations that have occurred to date support the interim actions, both in defining the extent of contamination needing corrective action and in selecting the technology used for the interim actions. The final cleanup action will be determined by processes described in the RI/FS Work Plan. Interim actions therefore must not foreclose reasonable alternatives (173-340-430 WAC).

# 2. REMEDIAL INVESTIGATION SUMMARY

The remedial investigation conducted to date is summarized in the RI/FS Work Plan. The Site Conceptual Model from that Work Plan is copied below to provide context for the interim action rationale to follow.

Waste disposal began in the northwest corner of the northern-most 40 acre parcel and proceeded first toward the east, and then south. Waste was initially deposited within both natural depressions and trenches excavated within the outwash soils above basalt. Waste in some or all areas of early disposal was burned. In general, hazardous waste was included in refuse disposed prior to 1981 when Resource Conservation and Recovery Act requirements changed that practice. At this site, the County ceased intentional disposal of industrial waste in 1975.

The water table rose about 30 feet in the early 1950s in response to leakage of water from irrigation works of the Columbia Basin Irrigation Project (Walters and Grolier 1960). The water table rose to saturate the lowest few feet of refuse over a limited area at the north end of the old landfill.

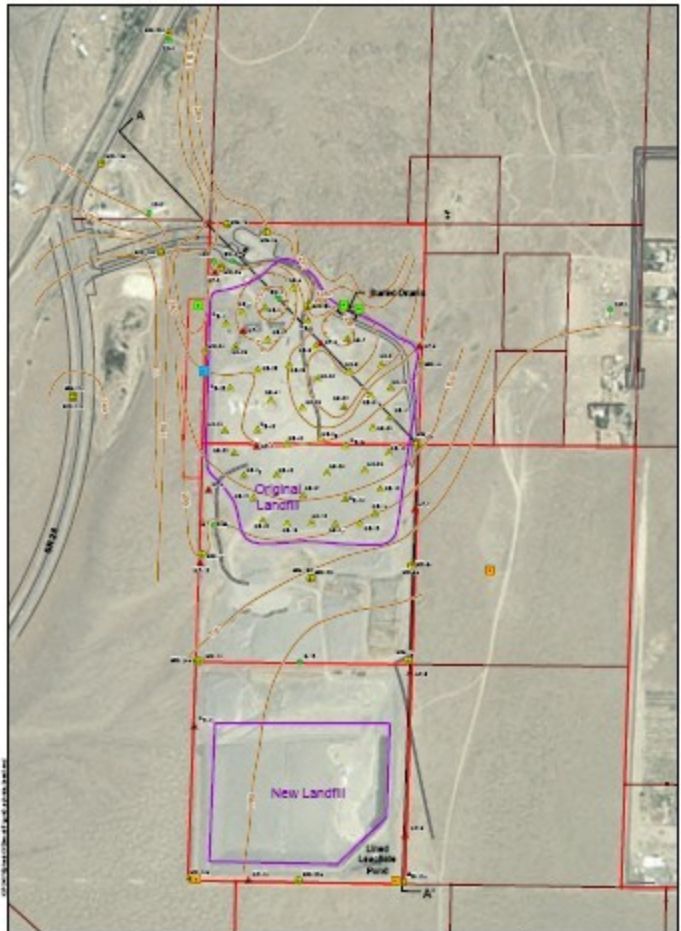
Sometime prior to 1983, a basalt aquifer – now called the Roza aquifer – and limited areas of groundwater within saturated outwash became contaminated with inorganic and organic contaminants as a result of leaching of refuse and possible migration of liquid wastes into the aquifer. These contaminated water bodies are not naturally well connected to other aquifers. Nonetheless, contaminants from this aquifer on the north end of the old landfill migrated slowly with groundwater, primarily downward and to the south, with limited migration now documented to the west. One probable route of downward migration was the old water supply well on the west edge of the old landfill (Figure 2) which penetrated the Roza aquifer and lower basalt aquifers with an open borehole until May 1986. Some contaminants degraded naturally along the flow paths and all contaminants were diluted by the large volumes of groundwater found in the larger downgradient aquifers – now called the Interflow aquifer and Outwash aquifer (Figure 3).

Other contaminant migration pathways to groundwater may be, or may have been, active. Landfill gas is generated by decomposing refuse. The gas contains low concentrations of volatile organic contaminants that evaporate from the refuse. The contaminants can diffuse or convect with the migrating landfill gas (which is largely methane and carbon dioxide). Subsequent diffusion into the underlying groundwater can result in groundwater contamination.

Another potential pathway of contaminant migration is leachate derived directly from newer refuse. Low volumes of seasonal precipitation and possible moisture created from decomposition move downward through the waste. Large volumes of water have been sprayed onto the newer parts of the old landfill to control fires within the refuse. Downward migration of these waters and leaching of constituents within the refuse could result in groundwater contamination within the Interflow and Outwash aquifers. In addition, poplar trees have been fertilized and irrigated near the landfill. Leaching of fertilizer constituents could appear to be landfill leachate. The Roza aquifer is not part of these potential contaminant pathways.

A plume of groundwater contamination is slowly expanding to the south with possible smaller components of flow to the east and west within the Interflow and Outwash aquifers. Downward migration to deeper basalt aquifers is also possible, but has been minor to date, except locally at the old supply well, which was pressure grouted and decommissioned in 1993. The mass of contaminants is dominated by common inorganic leachate constituents with lower concentrations of organic contaminants, including fuel constituents and chlorinated solvents. Preliminary evidence suggests both physical and chemical/biological attenuation is occurring.

The Roza aquifer does not extend off-site in downgradient directions. The Interflow and Outwash aquifers do extend off-site with the Interflow aquifer used in downgradient areas for domestic water supply. However, development in the area is sparse and the closest well toward the south is more than 2500 feet from the old landfill. The Outwash aquifer (with its artificially high water table) is drained by irrigation wasteways but supports wetlands and other surface water features with possible ecological value. Although the Columbia River lies west of the site, the basin structure promotes groundwater flow ultimately toward Moses Lake, which is several miles southeast of the landfill.


A
A'
Septic Drains
Original Landfill
New Landfill
Lined Leachate Pond
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Gas Extraction (GE)
Gas Probe (GP)
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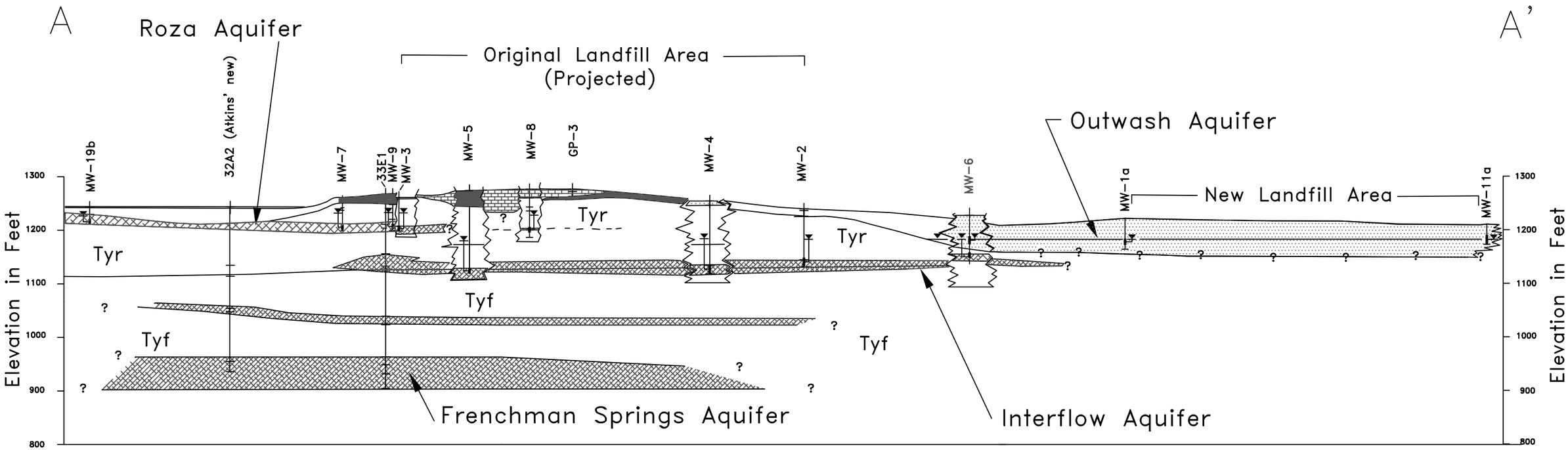


## Legend

- Outwash Gravel and Sand
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0 100 200 400 800

Horizontal Scale in Feet
Vertical Exaggeration 2X

FIGURE 3

CROSS SECTION A–A'

RI/FS Work Plan
Ephrata Landfill Corrective Action

PgG

# 3. RATIONALE FOR PROPOSED INTERIM REMEDIAL ACTIONS

The interim actions have been identified as effective methods for either removing sources of known contamination at the Ephrata Landfill or to reduce the potential for future transport of contamination offsite.

The buried drums at the northeastern corner of the landfill have been identified by Washington State Department of Ecology (Ecology) as a probable current or future source of contamination, the removal of which can be a discrete action that helps eliminate this future threat. The Hole has been identified as a likely source of contamination due to the presence of refuse below the water table. The extraction well (currently in place) provides the needed capacity to remove the groundwater from the refuse in the Hole and maintain a gradient toward the well.

The presumptive remedy for municipal landfill remediation endorsed by the U.S. Environmental Protection Agency, including closure capping, landfill gas controls, and surface water controls, is a widely recognized means of reducing the infiltration of precipitation into the landfill and thus infiltration of water from the refuse into the underlying vadose zone and groundwater. The caps also prevent direct human and animal contact with refuse, and thus contaminants. The gas controls prevent the offsite migration of landfill gas that can occur at a site surrounded by highly permeable gravelly soils after placement of a low-permeable cover. Landfill gas control also reduces diffusion of contaminants into groundwater. The surface water controls prevent the flow of water from offsite onto the landfill and ensures that stormwater flows from precipitation onto the cover do not damage the cover or impact neighboring property. Closure capping, gas control and surface water control are consistent with presumptive remedies under the Comprehensive Environmental Response, Compensation and Liabilitiy Act (CERCLA). Closure capping, landfill gas controls and surface water controls are also interim actions because they will likely be accomplished prior to or concurrent with RI/FS development and are anticipated cleanup action components.

# 4. DESCRIPTION AND EVALUATION OF PROPOSED INTERIM REMEDIAL ACTIONS

## 4.1 REMEDIAL ACTIONS FOR LANDFILL CLOSURE

The remedial actions for landfill closure include capping, landfill gas controls, and surface water controls.

### 4.1.1 Landfill Capping with Low-Permeable Cover

The final cover system inhibits or prevents the infiltration of incident precipitation and thus reduces production of leachate. The cover also prevents uncontrolled migration and emission of landfill gas and potential odors through the landfill surface. Proper design, construction, selection of materials, and effective revegetation or armoring prevents erosion of the cover. The cover system is an important component of the engineered systems that isolate waste constituents from the environment.

The final cover system proposed in the closure plan *Ephrata Landfill Permit Application* (Parametrix 2000) and in the preliminary final cover design documents (Parametrix 2004) meets applicable requirements of 40 Code of Federal Regulations (CFR) Part 258 (Subtitle D), and WAC 173-351-500.

For arid areas, requirements under WAC 173-351-500(1)(b) state that final covers must be designed and installed to minimize infiltration and erosion. Although Ephrata is located within an arid region, the design proposed complies with those standards identified for a non-arid region as follows:

- An anti-infiltration layer consisting of a 30-mil Polyvinyl chloride (PVC) geomembrane overlying a compacted soil layer.
- An 18-inch-thick soil layer placed over the geomembrane that will consist of on-site soils.
- An 8-inch armoring rock layer to prevent wind and water erosion.
- Final grades of at least 5 percent to address anticipated settlement.

The Hydrologic Evaluation of Landfill Performance Version 3 (HELP3) Model was used to evaluate the proposed final cover design, as well as the WAC 173-351 arid design cover. A comparison of the HELP3 model results for the arid design cover and the proposed cover is presented in Table 4-1. In summary, the HELP3 model indicated that the percentage of total precipitation that percolates through the barrier layer over 30 years averaged 8.2 percent for the arid design cover and 4.6 percent for the recommended cover. The HELP3 model summary results are displayed in Appendix A of the site Closure Plan.

It is anticipated that the landfill cap will prevent wildlife and plants from being exposed to hazardous substances via direct contact and thus negate the requirement for a terrestrial ecological evaluation according to WAC 173-340-7491(1)(b). An assessment of conformance with the exclusion requirements will be provided as part of the remedial investigation work.

**Table 4-1. Average Annual Totals for 30 Years for HELP3 Model Evaluation of Two Cover Alternatives at the Ephrata Landfill**

| Parameters | WAC Arid Design Cover | Recommended Cover |
|---|---|---|
| Precipitation | 7.80 inches 100% | 7.80 inches 100% |
| Runoff/Lateral Drainage | 0.29 inches 3.8% | 2.90 inches 36.9% |
| Evapotranspiration | 6.87 inches 88.1% | 4.54 inches 58.2% |
| Percolation through barrier layer | 0.64 inches 8.2% | 0.36 inches 4.6% |

### 4.1.2 Passive Landfill Gas Collection and Flaring

The landfill gas system will consist of vertical extraction wells (installed in Fall 2005), a gas condensate collection system, and a passive flaring system with a solar-charged continuous igniter. Vertical gas collection wells are spaced throughout the landfill.

The flare facility for the passive landfill gas collection system will be designed to provide for installing blowers for future conversion of the system from passive to active, if necessary. In preparing the Notice of Construction permit, which is required by Ecology's Air Quality Program, it was determined that a passive (versus active) system was the appropriate landfill gas collection system. An active system may be required as a result of offsite migration of landfill gas, or recommended if findings of the RI/FS indicate that an active system is a good means of reducing groundwater contamination relative to a passive system.

### 4.1.3 Surface Water Controls

One of the functions of the final cover is to divert stormwater runoff to perimeter surface water control structures. The drainage plan at closure will be a continuation of the system developed during landfill operation. Surface runoff from the landfill will be controlled by a series of diversion berms and ditches to direct surface water flow to constructed ditches and channels that convey the water to an infiltration pond (or infiltration ditch) located south of the landfill area. Surface water run-on from adjacent land is of minimal concern due to the landfill being the highpoint of its immediate drainage. The cover system will minimize erosion by the following:

- Rock armor placed over the cover soil
- Diversion of stormwater to perimeter ditches
- Mulching/erosion control measures in construction
- Timing of construction to end within planting season (October 1 to November 15) (Washington Stae Department of Transportation [WSDOT] 2006).

## 4.2 BURIED DRUM REMOVAL

This section describes the plans for the interim remedial actions of exploring the drum area and removing the buried drums and the relationship and timing with other interim actions and the cleanup action. The drums buried in the mid 1970s reportedly contain industrial wastes, including paint sludge and solvents. The physical condition of the drums is not known, although there has not been significant differential settlement in the drum burial area, which would typically occur if the drums were crushed and subsequently leaked. Drum area exploration will involve determining drum depth and drum disposal area perimeter and

analyzing several drum content samples. The process of drum removal will consist of overburden removal; drum sampling, drum removal, transport, and disposal; and subsurface soil testing and possible removal. Drum removal will need to be completed before landfill closure can be completed, although the closure work could start while the drum removal is underway.

### 4.2.1 Drum Area Exploration

Drum content, depth-to-top of the drums, and drum area perimeter need to be better defined in order for the County to obtain realistic and competitive bids for drum removal. Drum area exploration therefore needs to occur well in advance of drum removal in order to prepare accurate documents for bid solicitation. The County proposes to determine drum depth and confirm several perimeter drum locations by excavating a series of trenches to expose the tops of drums and analyze samples from several drums. Material excavated above the drums is not suspected to be dangerous or hazardous and will therefore be disposed of in the active landfill cell. Before performing field activities, the County will submit a sampling and analysis plan (SAP), quality assurance plan (QAP) and health and safety plan (H&SP) for the exploration. The above plans will describe protection monitoring required under 173-340-410 WAC. Since this interim action is strictly investigative, performance and confirmational monitoring requirements do not apply. The County will submit a summary report of exploration findings, including analytical results, survey data, and field observations.

### 4.2.2 Cover Soil and Refuse Removal and Disposal

The drums are covered with an estimated 12 feet of refuse and three feet of rock/gravel and surrounded on the sides by the same materials (overburden). As part of the drum removal interim action, this material will be removed to expose the drums. To the extent possible, the methods for overburden removal are intended to cause minimal disturbance to the underlying drums. This will be accomplished by using equipment with extended reach and removing overburden incrementally with drum removal (ensuring overall safety of construction crews). Because this overburden material is above and beside the drums, it is unlikely that the contents of the drums would have contaminated the overburden with the possible exception of materials directly adjacent to the drums. Therefore, the proposal is to place overburden in the active landfill. To the extent feasible, overburden soils will be segregated for use as daily cover. Overburden refuse and commingled refuse and soil will be disposed of as refuse. Overburden directly adjacent to the drums which is observably different in appearance, dampness or texture, emits different odors than other overburden, or is otherwise suspected of being contaminated will be segregated for designation pursuant to 173-303 WAC. Overburden designated as dangerous or extremely hazardous waste or hazardous debris will be disposed of offsite consistent with WAC 173-340-400 (9). Overburden that is not designated as dangerous or extremely hazardous waste will be disposed of in the active landfill. The designation process will be described in the drum removal SAP, to be prepared following drum area exploration. The drum removal contractor will be required to perform sampling and testing needed for designation, profiling, characterization and acceptance.

### 4.2.3 Drum Removal, Transport, and Disposal

After the overburden is removed, the drums will be removed for disposal. The removal, transport, and disposal of drums and their contents will be conducted by a private, third party vendor, with experience in this type of work. The process will consist of the following steps:

- Excavate drums to allow technicians access for sampling of content.

- Characterize and designate containers as necessary for regulatory compliance and proper disposal. Contents will be characterized for physical state (liquid and sludge) and chemical constituents (to determine transport, treatment, and disposal options, including British thermal unit (BTU) content of liquid).
- Prepare and repackage containers as necessary for transportation in compliance with state and federal Department of Transportation (DOT) regulations.
- Transport waste material to treatment and disposal facilities, as designated by the contractor consistent with WAC 173-340-400 (9).
- Process and dispose of waste materials in accordance with all applicable regulations.

A possible general waste management plan for the waste materials would be as follows (the ultimate plan will be at the discretion of the contractor, under state and federal regulations):

- Vacuum pumpable liquids for bulk transportation and disposal.
- Ship non-pumpable sludges in the existing drums when possible per DOT requirements
- Repackage damaged drums into over-pack drums as necessary for DOT compliance.
- Prior to acceptance of waste materials, contractors will require the submittal and subsequent approval of waste profile forms that accurately describe the waste materials.

There is a possibility that the drums will not be intact and must be removed as hazardous debris using mass excavation techniques. The approach would likely consist of excavation using a track-mounted excavator (the same or similar to that used for overburden removal) with direct placement of waste into sealed haul vehicles. Protocols for testing and manifesting will be similar to those used for suspected contaminated overburden, and the general contractor's methods will be required to ensure worker health and safety and to meet transport requirements. The plans and specifications for drum removal will include provision for some or all of the drums to be removed using these methods.

### 4.2.4 Subsurface Soil Testing and Remediation

If drums have been compromised by physical damage or corrosion, there is a likelihood of leaking of liquid wastes into the subsurface soils. An element of the RI/FS work plan is the testing of these soils for possible contamination. In the event that some of the underlying soils are contaminated, these soils would be excavated, transported, and disposed of at an appropriate disposal site. The excavation would be by tracked excavator or similar equipment to allow discrete removal of only those soils determined to be contaminated. The process for differentiating and designating potentially contaminated soil will be substantially the same as for potentially contaminated overburden.

It is possible that basaltic bedrock has also been contaminated by liquids leaking from the drums. It will probably not be possible to excavate the basalt bedrock. Contaminated bedrock that cannot be excavated will be left in place for possible final remedial actions determined through the RI/FS process. As noted in the RI/FS work plan, cleanup levels for soils (and bedrock) that cannot be excavated and that are not subject to direct human or environmental contact will be based on protection of groundwater.

Upon removal of contaminated soils and final testing confirming remaining soils have levels below clean-up levels, the excavated hole will be filled with stockpiled overburden material and other inert fill material. However, depending on conditions disclosed during excavation,

backfill may be delayed, or subsurface features may be constructed within the backfill to assist with final remedial actions. The locations and elevations of the drums, soil samples, and important subsurface geologic and landfill features will be surveyed during excavation to assist with the RI/FS and final actions.

## 4.3 GROUNDWATER FROM HOLE EXTRACTION AND TREATMENT

Groundwater will be pumped from extraction well (EW) -1, which is completed in saturated refuse and soils at the bottom of the Hole. Extraction of groundwater from the Hole will lower the water table within the Hole and thus reduce leaching of refuse to groundwater. Although a pumping test was performed using EW-1, the amount of drawdown expected from long-term pumping on this well is uncertain. Thus this interim action has both remedial and investigative functions.

The maximum sustainable pumping rate from well EW-1 is estimated to be 1 to 2 gallon per minute (gpm). One gpm is assumed for this interim action. Such a low pumping rate allows for several options for conveyance, treatment, and disposal.

### 4.3.1 Groundwater pumping and conveyance

The pumping rate of 1 gpm equates to a daily rate of 1,440 gal/day. Due to this low volume, it is proposed that the groundwater be pumped from the well into a trailer-mounted storage tank. This gives latitude for either hauling the contaminated water to an onsite or offsite location for treatment and disposal, or for gravity flow to a treatment system near the well.

### 4.3.2 Groundwater treatment and disposal

The EW-1 was installed in 2001. Sampling of this well in 2001 showed high concentrations of total dissolved solids (TDS), chloride, sulfate, iron, manganese, and sodium. Testing also showed elevated levels of volatile organic compounds (VOCs), including vinyl chloride.

The proposed treatment(s) of this relatively small quantity of contaminated groundwater consist of seasonal operation of the pump during the warmer and dryer time of the year (April through October) with onsite pond evaporation, or limited pre-treatment with discharge at a municipal wastewater treatment plant. Due to the limited duration of such a system (three to five years), the treatment system will be temporary in nature with decommissioning occurring at the end of treatment.

Groundwater level and quality measurements will be scheduled throughout the action to assist with operations and investigate the extent of, and effects of, water table decline.

# 5. SUPPLEMENTARY WORK PRODUCTS

Supplementary work products described below will be prepared pursuant to the interim action documentation requirements under 173-340-430 WAC.

## 5.1 ENGINEERING DESIGN

The engineering design objective is to develop plans, specifications, and estimates (PS&E), reports, operations and maintenance (O&M) manuals and permits (substantive requirements of exempted permits) for the interim actions consistent with the applicable requirements of WAC 173-340-400 (4) & (5). The main engineering deliverables include:

- Drum area exploration report.
- Drum removal and PS&E.
- Landfill closure PS&E and Construction Quality Assurance (CQA) Plan.
- Evaporation pond (for water from the Hole) PS&E and CQA Plan.

The County proceeded with the landfill closure, drum removal and evaporation pond designs contemporaneously with the development of this IRAP. Landfill gas wells were installed in 2005. Drum removal bids solicited in August, 2006 were rejected and the drum removal was not performed. Drum area exploration is now planned and the drum removal PS&E will be revised to reflect findings. The closure PS&E is at the 90 percent level of completion. PS&E for the evaporation pond, presently about 80 percent complete, will be submitted for 90 percent review upon incorporation of survey data to be provided by the County. Reports, plans and specifications will be distributed for review at appropriate levels of completion and finalized based on feedback.

Landfill closure and evaporation pond CQA Plans address quality control for geosynthetics and ordinary construction quality assurance procedures. CQA Plans are thus included as engineering deliverables for the landfill closure and evaporation pond. Although they are primarily construction documents, the CQA plans are consistent with applicable compliance monitoring and quality requirements of 173-340-410 & 820 WAC.

**PS&E.** The specifications will follow the format contained in "Washington State Department of Transportation 2006 Standard Specifications for Road, Bridge, and Municipal Construction." Cost estimates will reflect the engineer's opinion of probable cost based on estimated quantities of work and materials, professional judgment and experience. Estimates are not a guarantee of actual construction cost.

Drum Removal. Drum removal plans will include the following sheets:

1. Title Sheet, Vicinity Map, And Index To Drawings
2. Abbreviations, Legend, Site Plan, And General Notes
3. Work Area Plan
4. Sections

Landfill Closure. Closure plans will include the following sheets:

1. Title Sheet
2. Abbreviations, Legend and General Notes
3. North Closure Area
4. Central Closure Area

5. South Closure Area
6. Control Coordinate Schedule
7. Details and Sections
8. Sections
9 Sections
10. Sections
11. Details
12. Landfill Gas Plan
13. Details
14. Details
15. Flare Facility Plan
16. Details
17. Details
18. Gas Flare Details.

Evaporation Pond. Evaporation pond plans will include the following sheets:

1. Title Sheet, Vicinity Map, and Index to Drawings
2. Abbreviations, Legend, Site Plan, and Overall Site Plan
3. Grading Plan
4. Details

**Permits**. Permits and approvals and any substantive requirements of exempted permits not included in Exhibit E to the Agreed Order will be identified prior to bidding.

**Bidding.** The County will solicit and evaluate bids for the construction of the landfill closure and drum removal. The bidding process will occur over a 30-day period. This work will include the following activities:

- Address inquiries from prospective bidders and suppliers to provide clarification of design.
- Prepare addenda as necessary for contract amendment.
- Conduct a pre-bid meeting including a visit to the landfill site to familiarize prospective bidders with the site, discuss the major elements of the work, answer questions and address concerns.
- Prepare a pre-bid meeting summary to be issued to all plan holders in the form of an addendum.
- Prepare supplemental and revised contract drawings and specifications as needed for addenda.
- Review bids and prepare an engineer's statement of bid tabulation stating the apparent low bidder and recommendation for award.

**O&M**. O&M plans will be prepared as appropriate for each interim action that includes maintainable features (i.e.-equipment, piping, liner, cover system). O&M plans will be needed for the landfill closure and evaporation pond.

## 5.2 CONSTRUCTION

Construction will be conducted in accordance with approved plans and specifications and schedules. Construction will be documented consistent with the applicable requirements of WAC 173-340-400 (6)(b) as described below.

Drum Removal. The drum area exploration summary of findings mentioned previously will include survey data, photos, analytical results and field records.

Drum removal construction documentation will include field records, photographs, analytical results and survey data. Construction activities will be recorded in weekly reports during the removal and a summary report, including record drawings, following drum removal completion.

Landfill Closure. A CQA report will be prepared for the landfill closure activities that generally describes the progress of the work, any major design modifications and supporting regulatory approvals, and includes all inspection reports, tests, and completed CQA forms. The intent of the CQA report is to provide documentation to regulatory agencies that the project was completed in reasonable conformance with the approved contract documents.

The CQA report will contain the following:

- Construction summary report
- Material placement
- Daily field reports
- CQA inspection and installation forms
- Contractor's construction quality control (CQC) documentation
- Engineer's CQA declaration
- Manufacturer and Installation Warranties
- Photographic record
- Record drawings

Evaporation Pond. Evaporation pond construction documentation will include details such as field notes, photographs, test results, CQA forms and survey data. Construction activities will be recorded in weekly reports and a summary report, including record drawings.

## 5.3 COMPLIANCE MONITORING PLANS

A compliance monitoring plan meeting the requirements of 173-340-430 WAC is required for each interim action. Compliance monitoring plans will be developed incrementally, with initial emphasis on monitoring to ensure protection of human health and the environment during interim action construction. Drum area exploration SAP will address environmental protection during exploration. The exploration SAP will be further developed to address environmental protection during drum removal and the contractor will be required to prepare a waste management plan, including SAP elements and spill prevention and response. For landfill and evaporation pond construction, contractor prepared plans will address environmental protection during construction and the CQA Plans will include processes to ensure that improvements will support the achievement of cleanup objectives (to be developed as described in the RI/FS Work Plan). Health and safety plans will address protection of the public. Performance and confirmational monitoring elements specific to the interim actions will be included as appropriate in an overall compliance monitoring plan.

## 5.4 HEALTH AND SAFETY PLANS

H&SP will be developed by the County, its consultants, and contractors for their respective drum removal, landfill closure, and evaporation pond construction activities. Contractors will be required to address protection of the public in their plans. The consultant's drum area exploration H&SP will address protection of the public during exploration.

## 5.5 SAMPLING AND ANALYSIS PLANS

SAP will be developed for interim actions other than closure and evaporation pond construction, which are covered by CQA Plans. Each SAP will include appropriate quality assurance and control procedures, consistent with 173-340-820 WAC.

The drum area exploration SAP will include the sample collection approach, sample handling methods, anticipated test methods and laboratory quality procedures. The goal is to perform a complete analysis in order to provide information needed to plan drum removal sampling, analytical, disposal, and health and safety requirements.

The drum removal SAP will be developed based on the exploration findings. Sampling and analysis consistent with the requirements of 173-303 WAC will be required for drum and hazardous debris characterization, designation, profiling and acceptance. The contractor will be required to prepare a drum removal waste management plan including SAP and spill prevention and response, compatible with the SAP for underlying soils.

The SAP for soils underlying the buried drums will be developed consistent with activities described in the RI/FS work plan in conjunction with the drum removal waste management plan. A SAP for water level and water quality measurements from well EW-1 during extraction of groundwater from the Hole will also be prepared.

# 6. REFERENCES

Pacific Groundwater Group. 2006. Final Remedial Investigation/ Feasibility Study (RI/FS) Work Plan, Ephrata Landfill Corrective Action. Prepared for Grant County Department of Public Works and City of Ephrata by Pacific Groundwater Group, Seattle, Washington, September 2006.

Parametrix, Inc. 2000. Ephrata Landfill WAC 173-351 Permit Application. Prepared by Parametrix, Kirkland, Washington. October 2000.

Parametrix, Inc. 2004. 60 Percent Draft Submittal Ephrata Landfill Closure, Contract Documents and Specifications. Prepared by Parametrix, Bellevue, Washington. December 2004.

Walters, K.L. and M. J. Grolier. 1960. Geology and Ground Water Resources of the Columbia Basin Project Area, Washington. Washington State Water Supply Bulletin 8.

Washington State Department of Transportation. 2006. Standard Specifications for Road, Bridge, and Municipal Construction. Section 8-01.3(2), Dates for Application of Seed, Fertilizer, and Mulch.

**Ephrata Landfill RI/FS and Interim Action Schedule**

| ACTION | NUMBER OF MONTHS FROM AO EFFECTIVE DATE |
|---|---|
| Agreed Order Effective Date (at conclusion of public comment period) | 0 |
| Grant Application Submitted | 1 |
| Drum Area Exploration Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) /Health and Safety Plan (HSP) Submitted | 1 |
| Drum Area Exploration Work Begins | 1.5 |
| Public Participation Plan Developed | 2 |
| Drum Removal Bid Documents Revised and Published | 3 |
| Drum Removal and Extraction from the Hole SAP/QAPP/HSP Submitted | 3 |
| RI/FS SAP/QAPP/HSP Submitted | 3 |
| Drum Removal Field Work Begins | 5 |
| Pumping from the Hole Begins | 5 |
| RI Field Work Begins | 5 |
| RI Field Work Complete | 11 |
| Drum Removal Work Complete | 9 |
| Remedial Investigation Memo Submitted | 13 |
| Phase 2 Field Work Begins | 14 |
| Phase 2 Field Work Complete | 17 |
| RI/FS report submitted | 22 |
| Landfill Closure Construction begins | As soon as feasible, considering drum removal, weather and other construction constraints and conditions |

EXHIBIT E
REQUIRED PERMITS AND APPLICABLE SUBSTANTIVE PROVISIONS

Under RCW 70.105D.090, remedial actions conducted pursuant to an Agreed Order are exempt from the procedural requirements of Ch. 70.94 RCW, the Washington Clean Air Act, Ch. 70.95 RCW, the Solid Waste Management, Reduction and Recycling Act, Ch. 70.105 RCW, Hazardous Waste Management Act, Ch. 75.20 RCW (now 77.55), Construction Projects in State Waters Act, Ch. 90.48 RCW, Water Pollution Control Act, and Ch. 90.58 RCW, Shoreline Management Act, and the procedural requirements of any laws requiring or authorizing local government permits or approvals for the remedial action.

This order requires a group of remedial actions be taken at the site. They include:

- Excavation and removal of buried drums, transporting and off-site disposal of the drums and their contents, evaluation of the soils underlying the drum disposal area, and potentially, additional remedial activities, like soil venting;

- Extraction, treatment and disposal of contaminated water from "the Hole";

- Undertaking a remedial investigation of the nature and extent of contamination at the site and developing a feasibility study of possible additional remedial actions;

- Construction of a landfill cover system and construction and operation of a landfill gas collection and treatment system.

This Agreed Order does not include any remedial actions for which permits or approvals would be required under either Ch. 77.55 RCW, Construction Projects in State Waters or Ch. 90.58 RCW, Shoreline Management Act, so they will not be considered in this exhibit. If the parties agree upon other remedial actions to be undertaken at the site, they will be evaluated to ascertain whether these statutes are triggered.

Each of the remedial actions is described in the following tables. Potentially applicable statutes and regulations are listed together with the substantive requirements that apply to each remedial action.

## I. Excavate and Remove Drums

**Project description:**

Approximately 2,000 buried steel "55 gallon" drums will be removed from the Ephrata Landfill. The project will begin by "potholing" the area to determine the boundaries of the drum area and the elevation of the top of the drums. Next, the overburden will be removed without driving heavy equipment over the drums or otherwise damaging them. The excavated overburden will be stored in covered stockpiles and returned to the void after the drums are removed.

Overburden and surrounding materials will be removed as necessary to provide a safe access to the drums. All refuse exposed by the excavation will be covered with either at least six inches of soil or an approved temporary membrane.

The drums are anticipated to contain solidified paint sludges, inorganics, and organic solvents from manufacturing sources. The drums and their contents, as well as any debris resulting from disintegration of the drums and their contents, may designate as dangerous waste or extremely hazardous waste. In addition, the soils between and beneath the drums may be contaminated. These materials will be sampled and the samples analyzed to determine whether they designate as dangerous waste and to characterize and profile the material for transport and disposal.

**Table 1. Procedural and Substantive Requirements of Statutes, Regulations and Local Ordinances Applicable to Excavation and Removal of Drums**

| STATE OR LOCAL LAW | PROCEDURAL REQUIREMENTS | SUBSTANTIVE REQUIREMENTS |
|---|---|---|
| **Local Ordinances and Rules** | | |
| | | |
| | Grading Permit – waived by statute | |
| | | |
| **State Statutes and Regulations** | | |
| Ch. 70.94 RCW – Clean Air Act | | |
| Ch. 173-400 WAC – General Regulations for Air Pollution Sources | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Apply best available control technology (BACT) to emissions from drum burial area and comply with ambient air quality standards. |
| Ch. 173-460 WAC – Controls for New Sources of Toxic Air Pollutants | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Apply best available control technology for toxics (T-BACT) to emissions from drum burial area and control ambient air quality impacts. |

| | | |
|---|---|---|
| Ch. 70.95 RCW – Solid Waste Management | | |
| Ch. 173-350 WAC – Solid Waste Handling Standards | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Storage and handling of refuse and other solid wastes (not regulated under Chs 173-303 and 173-351 WAC) are subject to the requirements of Ch. 173-350 WAC. Applicable requirements for planned activities under Ch. 173-350 WAC may include, but are not limited to: WAC 173-350-320 – Piles used for storage or treatment. |
| Ch. 173-351 WAC – Criteria for Municipal Solid Waste Landfills | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Landfilling of municipal solid waste (not regulated under Ch. 173-303 WAC is subject to the requirements of Ch. 173-351 WAC. All refuse and other solid wastes excavated as part of the planned activities must be placed in the permitted municipal solid waste landfill unit or otherwise meet the substantive requirements of Ch. 173-351 WAC. Grant County must continue compliance with the solid waste handling permit issued by Grant County Health District except for actions directly addressed in this Agreed Order. See WAC 173-351-460 and WAC 173-350-900(1). |
| Ch. 70.105 RCW – Hazardous Waste Management Act | | |
| Ch. 173-303 WAC – Dangerous Waste Regulations | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | The drums and their contents, as well as any debris resulting from disintegration of the drums and their contents, will be subject to the designation requirements of the Dangerous Waste Regulations, Ch. 173-303 WAC, when removed from the burial location.<br><br>The County will become a generator of hazardous waste when the drums are excavated, |

| | | |
|---|---|---|
| | | and will be required to meet the generator requirements of WAC 173-303-170, including, but not limited to: designating wastes, assigning an EPA ID number, meeting waste accumulation standards, preparing wastes for transport, land disposal restrictions, manifests, recordkeeping, and reporting.<br><br>Some methods of storage, on-site treatment, or handling would add additional requirements. WAC 173-303.<br><br>Persons transporting dangerous waste drums and debris are subject to the transporter requirements of WAC 173-303-240. |
| Ch. 46.48 RCW – Transportation of Hazardous Materials | | |
| Adopts 49 CFR Part 172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, And Training Requirements. | No permits or procedural requirements in this law. | Requirements include marking of packages, shipping papers, placarding, emergency response, training, and planning. |

## II. Extract Groundwater from the Hole with Treatment or Disposal

**Project Description:**

The Hole is a subsurface depression in the basalt beneath the old landfill located in the northwest corner of the old landfill. It is 10 to 20 feet deep and about 450 feet in diameter. The bottom of the depression is filled with a sediment-refuse mix. The bottom 7-10 feet of the soils and refuse in the Hole is saturated with water. The water will be pumped out of the Hole through well EW-1. This well is in place, so no additional drilling will be required through refuse.

The anticipated rate of pumping from EW-1 is approximately 1-2 gallons per minute. At that rate, the volume of water produced daily will be approximately 1,400 gallons. The water will be pumped into a trailer-mounted storage container. The proposed treatment of this water is either evaporation from an on-site pond or limited pre-treatment with discharge to the Ephrata sewage treatment plant.

**Table 2. Procedural and Substantive Requirements of Statutes, Regulations and Local Ordinances Applicable to Extraction of Groundwater from the Hole with Treatment or Disposal**

| STATE OR LOCAL LAW | PROCEDURAL REQUIREMENTS | SUBSTANTIVE REQUIREMENTS |
|---|---|---|
| **Local Ordinances and Rules** | | |
| | | |
| | Grading Permit – waived by statute | |
| | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | |
| | | |
| **State Statutes and Regulations** | | |
| Ch. 70.94 RCW – Clean Air Act | | |
| Ch. 173-400 WAC – General Regulations for Air Pollution Sources | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Apply best available control technology (BACT) to emissions and potential emissions from project and comply with ambient air quality standards. |
| Ch. 173-460 WAC – Controls for New Sources of Toxic Air Pollutants | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Apply best available control technology for toxics (T-BACT) to emissions and potential emissions from project and control ambient air quality |

| | | |
|---|---|---|
| | | impacts. Evaluation of possible emissions from pond. Impacts from evaporation or other treatment of water from the Hole must be evaluated. |
| Ch. 70.95 RCW – Solid Waste Management | | |
| Ch. 173-350 WAC – Solid Waste Handling Standards | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | On-site storage and handling of leachate (not regulated under Ch. 173-303 WAC) is subject to the requirements of Ch. 173-350 WAC.<br><br>Construction of a new surface impoundment or use of a storage tank must conform to the substantive requirements of WAC 173-350-330. Grant County must continue compliance with the solid waste handling permit issued by Grant County Health District for the facility except for activities directly addressed in the Agreed Order. See WAC 173-350-900(1). |
| Ch. 70.105 RCW – Hazardous Waste Management Act | | |
| Ch. 173-303 WAC – Dangerous Waste Regulations | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Based on previous sampling, no applicable requirements are anticipated. Water pumped from the Hole will need characterization. Generator requirements will apply if water designates as dangerous waste. Treatment of water would add additional requirements. |
| Ch. 90.48 RCW – Water Pollution Control | | |
| Ch. 173-216 WAC – State Waste Discharge Program | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Any discharge of water of extracted from the Hole to the Ephrata treatment plant must meet pre-treatment requirements. |
| Ch. 173-200 WAC – Ground Water Quality Standards for the State of Washington | NA | Ch. 173-200 WAC does not apply to clean up actions approved by the Department of Ecology under the Model Toxics |

| | | |
|---|---|---|
| | | Control Act, Ch. 70.105D RCW, see WAC 173-200-010(3)(c). |
| Ch. 18.104 RCW – Water Well Construction | | |
| Chapter 173-160 WAC – Minimum Standards for Construction and Maintenance of Wells | Remedial actions conducted pursuant to an Agreed Order are not exempt from Ch. 18.104 RCW procedural requirements. | No additional wells are planned to be constructed for this interim action. Ecology must be notified of the intent to begin well reconstruction-alteration, or decommissioning procedures at least seventy-two hours before starting work. |

## III. Remedial Investigation and Feasibility Study

**Project Description:**

PLPs will conduct a remedial investigation (RI) to determine the nature and extent of contamination at the site and a feasibility study (FS) to identify and evaluate possible additional remedial actions to address the contamination. Existing information about site conditions informs the scope and nature of additional investigation at the site.

There are several specific tasks included in the RI. The extent of contamination released from the buried drums described above will be investigated. Second, test pits will be dug in the northern part of the landfill to identify additional sources of contamination in that area of the landfill. Next, the extent of groundwater contamination will be delineated. Wells will be installed and sampled in three aquifers, the Interflow, the Roza and the Frenchman Springs Aquifers. Data from the new wells and existing wells at the site will be analyzed. Data gaps will be identified and additional work performed, if necessary. The data will also be used to formulate remedial alternatives to be evaluated in the FS.

**Table 3. Procedural and Substantive Requirements of Statutes, Regulations and Local Ordinances Applicable to the Remedial Investigation and Feasibility Study**

| STATE OR LOCAL LAW | PROCEDURAL REQUIREMENTS | SUBSTANTIVE REQUIREMENTS |
|---|---|---|
| **Local Ordinances and Rules** | | |
| | | |
| **State Statutes and Regulations** | | |
| Ch. 70.95 RCW – Solid Waste Management | | |
| Ch. 173-351 WAC – Criteria for Municipal Solid Waste Landfills | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Comply with groundwater monitoring requirements – detection monitoring WAC 173-351-430; assessment monitoring and corrective action requirements, WAC 173-351-400 as applicable.<br><br>Grant County must continue compliance with the solid waste handling permit issued by Grant County Health District for the facility except for activities directly addressed in the Agreed Order. See WAC 173-351-460. Environmental monitoring requires conformance with |

| | | |
|---|---|---|
| | | approved plan of operation.<br><br>Local health department may participate in negotiations and review and comment upon any reports submitted to Ecology. WAC 173-351-460. Ecology shall perform as described in Ch. 70.105D RCW and Ch. 173-340 WAC, WAC 173-351-465. |
| Ch. 70.105 RCW – Hazardous Waste Management Act | | |
| Ch. 173-303 WAC – Dangerous Waste Regulations | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Wastes excavated from test pits may designate as dangerous waste. Wastes from investigative activities must be characterized for handling and disposal as required by Ch. 173-303 WAC. |
| Ch. 18.104 RCW – Water Well Construction | | |
| Ch. 173-160 WAC – Minimum Standards for Construction and Maintenance of Wells | Remedial actions conducted pursuant to an Agreed Order are **not** exempt from Ch. 18.104 RCW procedural requirements. | Ecology must be notified of the intent to begin well construction, reconstruction-alteration, or decommissioning procedures at least seventy-two hours before starting work. Wells must be constructed in conformance with all requirements. |
| Ch. 173-162 WAC – Regulation and Licensing of Well Contractors and Operators | Remedial actions conducted pursuant to an Agreed Order are **not** exempt from Ch. 18.104 RCW procedural requirements. | A resource protection well operator's license is required for construction or decommissioning resource protection wells and for geotechnical soil borings. |

## IV. Construct Closure System and Post-Closure Monitoring for Old Landfill

**Project Description:**

A cap system that meets the criteria of Ch. 173-351 WAC for non-arid area landfills will be constructed over the landfill. In addition, a passive landfill gas control system will be completed at the site. Vertical gas extraction wells were installed in 2005. A flare with solar-powered continuous igniter will be constructed. Finally, a surface water management system designed to divert water away from the landfill will be designed and constructed. A closure plan and preliminary final cover design documents have been submitted to the jurisdictional health department.

**Table 4. Procedural and Substantive Requirements of Statutes, Regulations and Local Ordinances Applicable to Constructing the Closure System and Post-Closure Monitoring of the Old Landfill**

| STATE OR LOCAL LAW | PROCEDURAL REQUIREMENTS | SUBSTANTIVE REQUIREMENTS |
|---|---|---|
| **Local Ordinances and Rules** | | |
| | | |
| **State Statutes and Regulations** | | |
| Ch. 70.94 RCW – Clean Air Act | | |
| Ch. 173-400 WAC – General Regulations for Air Pollution Sources | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Installation of the closure system triggers new source review, application of best available control technology (BACT) and compliance with ambient air quality standards. Ecology is the air authority for this project. Ecology issued a letter that confirms that a Title V air operating permit will not be required for the site so long as the combined existing landfill and expansion area landfill capacity is under 2.5 megagrams (the 40 CFR 60 Subpart WWW threshold.) The Notice of Construction for the landfill will be revised and re-submitted to Ecology to adjust the total design capacity of the combined landfills to be under 2.5 megagrams. |

| | | |
|---|---|---|
| Ch. 173-460 WAC – Controls for New Sources of Toxic Air Pollutants | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Installation of the closure system triggers new source review, application of best available control technology for toxics (T-BACT) and control of ambient air quality impacts. |
| Ch. 70.95 RCW – Solid Waste Management | | |
| Ch. 173-351 WAC – Criteria for Municipal Solid Waste Landfills | Remedial actions conducted pursuant to an Agreed Order are exempt from procedural requirements. | Closure and post-closure maintenance of cover system must conform to substantive requirements of Ch. 173-351 WAC.<br><br>Local health department may participate in negotiations and review and comment upon any reports submitted to Ecology WAC 173-351-460; Ecology shall perform as described in Ch. 70.105D RCW and Ch. 173-340 WAC, WAC 173-351-465.<br><br>Grant County must continue compliance with the solid wasate handling permit issued by Grant County Health District for the facility except for activities directly addressed in the Agreed Order. See WAC 173-351-460. |

# Public Participation Plan
## for the
## Ephrata Landfill Remedial Action

**As required by**
**Agreed Order No. DE 3810**

**Washington State Department of Ecology**
**Grant County**
**City of Ephrata**

**October 10, 2007**

# Opportunities to Participate

## What is a Public Participation Plan?

This Public Participation Plan is a document that provides information about how citizens may become involved in the decision-making at certain stages of cleanup at the Ephrata Landfill site. The site is located three miles south of the City of Ephrata, on the east side of Highway 28 in Grant County, Washington (see Appendix A for Site Map).

The Plan is part of an Agreed Order signed by The Department of Ecology (Ecology) and the City of Ephrata and Grant County. The Order names the City and County as Potentially Liable Parties (PLPs) and requires them to conduct a Remedial Investigation and Feasibility Study at the Ephrata Landfill. The remedial investigation will determine the extent of contamination in soil and groundwater at the site. The feasibility study will evaluate cleanup alternatives. The Order also requires interim actions, which include removal of about 2,000 drums of waste and contaminated soils from the landfill.

## Why Have a Public Participation Plan?

Washington State's cleanup law, the Model Toxics Control Act (MTCA), chapter 70.105D RCW and chapter 173-340-600 WAC, requires Ecology and the PLPs to develop a Public Participation Plan for each cleanup site. The goal of the Public Participation Plan is to provide the public with timely information and meaningful opportunities for participation that are commensurate with each site. It also serves as a way of gathering information from the public that will help Ecology, the City of Ephrata and Grant County with the investigation and planning for cleanup. The Plan will help the community living near the site, as well as the general public, keep informed about cleanup activities and how they may participate in the process.

Ecology will review the Plan as the cleanup progresses and may, working cooperatively with Grant County and the City of Ephrata, amend it if necessary. Amendments may also occur as part of a public comment period associated with cleanup documents at future stages of cleanup. Cleaning up the Ephrata Landfill site is important to the environmental quality of the Ephrata area and to its citizens, the City of Ephrata, Grant County, and Ecology. The "environment" is not just the natural condition of a place or area, but the interdependence of natural and socio-economic values. It is critical to look at all interests when selecting the best approach to cleanup the site.

Public input is an important part of the cleanup process since the public is familiar with the community, its history, and its values. Ecology's goal is to facilitate collaborative partnerships with all concerned about the effects of contaminants at the site. Public approval helps avoid delay, frustrations, and excess costs. Greater public input leads to a more successful project.

## How Can I Become Involved?

Ecology, the City of Ephrata and Grant County invite you to become involved in the decision-making process of the cleanup. The following are some ways to participate:

- Visit Ecology's web site for the Ephrata landfill site to learn more about the site and about the MTCA process.
- Get on the mailing list to receive information about the site.
- Contact the key people involved in the site cleanup for information (see next section for a list of contacts).
- Read fact sheets and comment on documents out for public comment.
- Attend meetings that explain the cleanup actions.

## How Can I Find Out More?

Ecology staff are available to answer questions about specific cleanup issues, the process in general, or other questions related to the site. Staff can also help provide information on related environmental regulations and help find specific documents that may be of interest. E-mail or letters are the preferred form of communication as fieldwork will occasionally take staff away from their phones. In addition, personnel from Grant County and the City of Ephrata can answer questions about the cleanup and day-to-day activities on the site. If you have questions about the Ephrata Landfill site or the cleanup process in general, please contact one of the individuals listed below:

<table>
<tr>
<td rowspan="2">Ecology Site Manager<br><br>Cole H. Carter<br>Department of Ecology<br>Eastern Regional Office<br>4601 N. Monroe Street<br>Spokane, WA 99205<br>509/981-5948<br>e-mail: coca461@ecy.wa.gov</td>
<td>Spanish contact<br><br>Para asistencia en Espanol<br>Sr. Gregory Bohn<br>Phone: 509/454-4171</td>
</tr>
<tr>
<td>Russian contact<br><br>Для помощи на русском языке<br>Ms. Tatyana Bistrevsky<br>Phone: 509/477-3881</td>
</tr>
<tr>
<td>Grant County contact<br><br>Derek Pohle, P.E.<br>Public Works Director/County Engineer<br>124 Enterprise Street S.E.<br>Ephrata, WA 98823<br>509/754-6084</td>
<td>City of Ephrata contact<br><br>Wes Crago<br>City Administrator<br>121 Adler Street S.W.<br>Ephrata, WA 98823<br>509/754-4601</td>
</tr>
</table>

Information about the site, including the Agreed Order and appendices, is available on-line at Ecology's Ephrata Landfill website at the following address.
http://www.ecy.wa.gov/programs/tcp/sites/ephrata_lf/ephrata_lf_hp.htm.

## Background Information

### Geology

The Columbia Basin area of central Washington state is underlain by volcanic rocks of the Columbia River Basalt Group. Ice dams melted about 15,000 years ago at the end of the last ice age, resulting in catastrophic flooding. This flooding created erosional channels in the basalt and deposited alluvial materials. The aquifers that underlie the landfill site are located in the outwash deposits and interbeds and

rubble zones in the basalt layers. The uppermost aquifer is about 32 feet below ground surface. At least three aquifers underlie the landfill site. Flow direction of the aquifers is generally to the south to southeast although the Rosa aquifer flows westerly at the northern portion of the site.

**Community Information**

The population of Ephrata was 6808 people in the year 2000. City-data.com says 10.3% of the population of Ephrata is Hispanic. According to the 2005 census, 33.8% of the population of Grant county is Hispanic. Several Russian-speaking families have also settled in the area.

**Landfill Location and Operations History**

The Ephrata Landfill is three miles south of the City of Ephrata, on the east side of Highway 28. Grant County currently owns and manages the 125 acre landfill site. The City of Ephrata began operations at the site in about 1942 and owned and managed the landfill until 1974. About 2000 drums of industrial waste were buried at the landfill in August 1975. During the time the City ran the landfill, it leased more property for the landfill from the U. S. Bureau of Reclamation. In 1974, Grant County took over operations of the landfill. In 1994, the City deeded the entire property to the County. Before 1962, the landfill was an open dump, and it ran continuously as an unlined cell until a new lined cell opened in 2005.

**Contaminants**

The Environmental Protection Agency (EPA) added the site to a list of potential hazardous sites in 1979. The Washington State Department of Ecology completed an Initial Investigation in 1987and ranked the site as a 5 on a scale of 1 to 5. A rank of 5 represents the lowest level of concern relative to the other sites. Groundwater sampling at the site began in 1988. A 1990 assessment report noted high contaminant concentrations in groundwater in the uppermost aquifer. After discussions with Ecology in 2000, the County installed two extraction wells as part of a voluntary cleanup program. Recent sampling shows contamination with metals, solvents, and other chemicals in the upper three aquifers. Contaminants include 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, vinyl chloride and other breakdown products, benzene, toluene, xylenes, and the pesticide 1,2-dichloropropane. The buried drums and waste in the old landfill cell may be contributing to the contamination. Some of the contaminants detected in groundwater at the site are the same chemicals noted during preliminary sampling of the drums. Continuing weakening of the drums may be releasing chemicals into the soil and groundwater. The County has finished adding waste to the portion of the landfill near the drums and that cell is awaiting capping and closure.

**Agreed Order**

Ecology issued Final Determinations of Potentially Liable Person (PLP) status to the City of Ephrata and Grant County on January 10, 2005. Since that time, the PLPs and Ecology have negotiated an Agreed Order for the investigation and cleanup of the landfill. An Agreed Order (AO) is a legal document discussed in MTCA in which a PLP agrees to perform cleanup at the site following the agreed terms. Negotiations for the AO began in October 2005 and were completed in January 2007. Before finalizing the AO, Ecology sought input from the public as described on the following page.

**Remedial Investigation/Feasibility Study**

The Agreed Order specifies that a Remedial Investigation/Feasibility Study and Interim Actions will be performed at the landfill. The purpose of a remedial investigation/feasibility (RI/FS) study is to collect, develop, and evaluate enough information about a site to select a cleanup action. The *Final Remedial Investigation/Feasibility Study Work Plan,* which is Exhibit B of the Agreed Order, discusses specific tasks in the RI/FS.

**Interim Actions**

In some situations, an Agreed Order may require Interim Actions as described in WAC 173-340-430. The following situations may require Interim Actions:

- A current threat warrants an immediate response,
- Contamination in specific areas is at levels that need prompt treatment, or
- A problem may get worse without expedited cleanup actions.

Ecology does not believe that a threat from contamination at the Ephrata Landfill warrants an immediate response or that contamination is at levels that need immediate treatment. However, the contamination in the groundwater could get worse as the buried drums deteriorate. The Interim Actions at the Ephrata Landfill include the removal of the buried drums and disposal of the drums and contents. Other Interim Actions at the Ephrata Landfill include pumping groundwater out of the aquifer at a low spot in the old section of the landfill and capping the old part of the landfill.

Site-specific Health & Safety Plans will be developed for each Interim Action. The Health & Safety Plans address procedures to minimize the risk of chemical exposure, physical accidents, and environmental contamination.

**Remedial Action Grant**

In 2006 the PLPs applied for a Remedial Action Grant from Ecology to help cover the cost of the RI/FS and interim actions required in the Agreed Order. In 2007, they received a grant of $2.29 million. As the cleanup progresses at the site, the PLPs may apply for more grants.

**Public Process for the Agreed Order**

Before finalizing the Agreed Order (AO), Ecology conducted interviews in the community, developed a mailing list of interested persons, and sent fact sheets about the AO in English, Spanish, and Russian to everyone on the mailing list (see page 7). Ecology also provided a 30-day period for the public to provide comments on the AO and, on February 8, 2007, held a public meeting to discuss the AO and answer questions from the public. Ecology then prepared a Responsiveness Summary discussing community outreach for the Agreed Order. The Responsiveness Summary includes the comment forms from the community interviews, fact sheets on the AO, copies of letters from individuals with responses from Ecology, and public meeting presentation slides. This Responsiveness Summary was released to the public and is available at the Ephrata Landfill website and the repositories.

**The Model Toxics Control Act**

In November 1988, voters passed Initiative 97, which went into effect in March of 1989 as Chapter 70.105D RCW, the *Model Toxics Control Act (MTCA)*. MTCA changed the way that hazardous waste sites in the state are cleaned up. It provides a clear and efficient process to clean up chemical contamination of soils, sediments, surface water, and groundwater to levels that are protective of people and the environment. Representatives from citizen, environmental, and industry groups developed the implementing MTCA regulations with the Federal Superfund Law as a model.

MTCA (Appendix B) and chapter 173-340 WAC are the laws that regulate the cleanup at the Ephrata Landfill. Ecology administers the MTCA regulations. MTCA does the following:

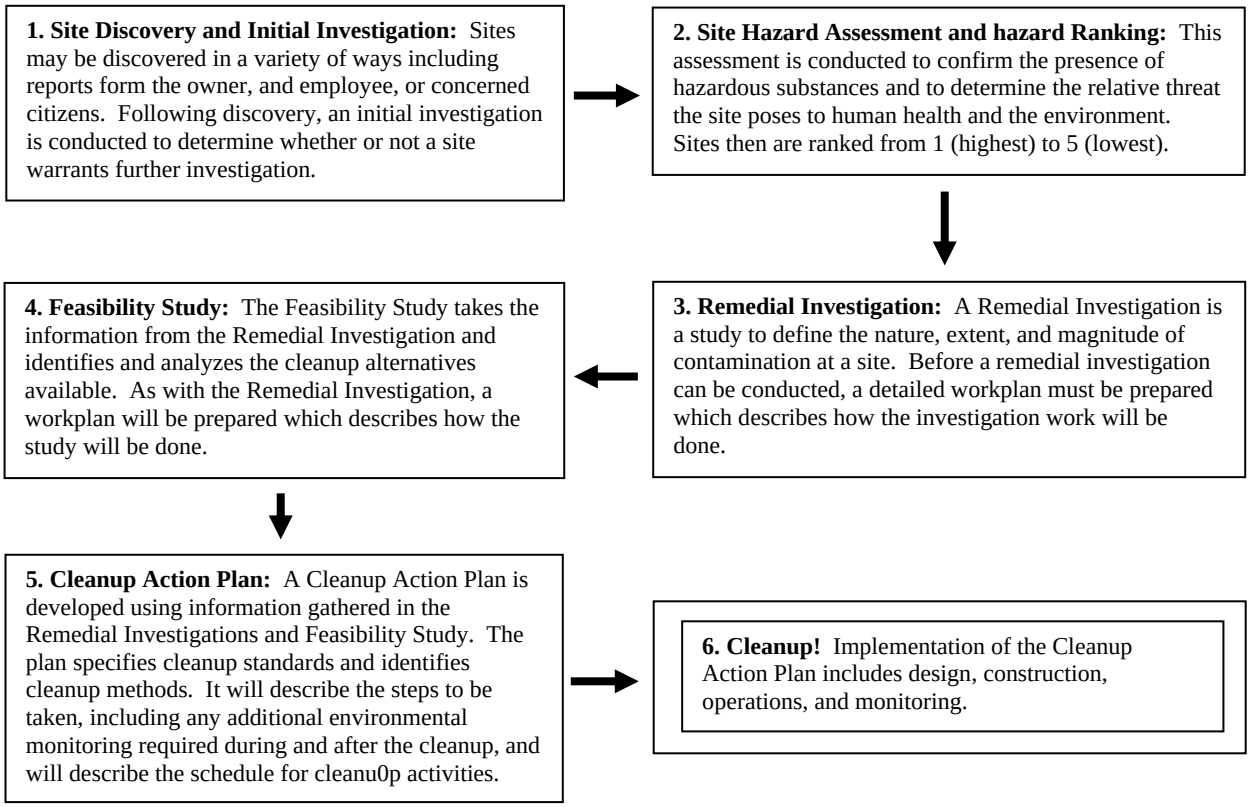
- Promotes cooperative cleanup agreements between Ecology and the responsible parties.

- Encourages an open process for the public, local government, and liable parties to discuss cleanup options and community concerns. Public awareness and involvement are keystones to the success of any MTCA cleanup.

Under MTCA, PLPs are responsible for researching and cleaning up the contamination. Although Ecology has the legal authority to order a liable party to perform a cleanup action, the department prefers to approach cleanups cooperatively. Ecology oversees each step of the cleanup to ensure that investigations, public involvement, cleanup, and monitoring are completed. The liable party pays the costs for this oversight.

## Steps in the State Cleanup Process

The MTCA rules detail each step in the cleanup process to ensure that cleanups are thorough and protective of human health and the environment. The chart below defines these steps and how they apply to the project site. Legal documents such as "Agreed Orders" or "Consent Decrees" further define some of the steps and associated time frames.




The cleanup process is complex. During the process, issues often arise that need more scrutiny or evaluation, and may lead to changes in the scope or timing of the project. At the same time, it is in everyone's interest to complete a cleanup as quickly as possible. Therefore, Ecology and the PLPs must work together to address issues that arise as efficiently as possible in order to avoid delays.

# Public Involvement Opportunities

The Model Toxics Control Act cleanup process (WAC 173-340-600) emphasizes giving the public the chance to review and provide suggestions on cleanup decisions at all major steps in the process. The Agreed Order that applies to this project requires Ecology, the City of Ephrata, and Grant County to work cooperatively to provide the public with timely information, an understanding of the process, and

opportunities to review and comment on proposed cleanup decisions. Ecology will provide continuing updates on the cleanup and monitoring. Table 1 gives a detailed list of proposed public involvement milestones for the Ephrata Landfill project.

**TABLE 1**
**Public Involvement Milestones (bold) and Associated Steps for the Investigation and Cleanup of the Ephrata Landfill Site**

| MILESTONE | DATE or ESTIMATED DATE |
|---|---|
| **Agreed Order (AO) signed by Grant County and the City of Ephrata. The AO includes a schedule for an Remedial Investigation/Feasibility Study and an Interim Action.** | December 2006 |
| Fact Sheets about the Agreed Order and the SEPA Determination of Non-significance mailed. | December 27, 2006 |
| Legal Notice published in the Columbia Basin Herald and in the Grant County Journal | December 29, 2006 |
| Legal Notice published in Spanish in El Mundo | January 4, 2007 |
| Public Comment Period for SEPA | December 22, 2006 – January 12, 2007 |
| Public Comment Period for the Agreed Order | December 28, 2006 – February 15, 2007 |
| Agreed Order signed by Ecology and goes into effect. | January 30, 2007 |
| Public Meeting to discuss the Ephrata Landfill Agreed Order for Remedial Action. | February 8, 2007 |
| **Responsiveness Summary completed** | March 26, 2007 |
| **Draft Remedial Investigation/Feasibility Study (RI/FS) report to be submitted.** | December 2008 |
| Public Comment Period for the RI/FS. | January – February 2009 |
| Public Meeting to discuss RI/FS (if requested by 10 or more people) | January 2009 |
| RI/FS becomes final | February 2009 |
| **Draft Cleanup Action Plan (CAP) available for public review.** | March 2009 |
| Public Comment Period for the draft CAP | April 2009 |
| Public Meeting to discuss CAP (if requested by 10 or more people) | April 2009 |
| CAP finalized after public comment period. | May 2009 |
| Cleanup implementation. | June 2009 (continues until completed) |

For each public involvement milestone, Ecology will provide public notice using a variety of methods. Some of the methods for public notice are outlined below. Certain stages of cleanup require a public comment period of at least 30 days. Ecology may extend the comment period depending on the complexities of the material or if the public requests an extension.

- **Mailing List –** Prior to finalizing the Agreed Order, Ecology developed a mailing list of individuals who live near the site. The potentially affected vicinity covers any adjacent properties and homes or businesses close to the site and areas that will be investigated. People in the affected area will receive copies of all fact sheets about the cleanup process by first-class mail. Also; individuals, organizations, local, state and federal governments, and any other interested parties will be added to the mailing list as requested. Interested people may request to

be on the mailing list by contacting Cole Carter at the Department of Ecology. See Appendix C for a copy of the mailing list.

- **Fact and Focus Sheets –** Ecology creates fact sheets during various stages of the cleanup and delivers them to individuals on the mailing list. These fact sheets explain the stage of cleanup, the site background, and what happens next in the cleanup. They may also ask for comments from the public. A 30-day comment period allows interested parties time to comment on the process. The fact sheets are also available on Ecology's Web Site under the Toxics Cleanup Program at http://www.ecy.wa.gov/programs/tcp/sites/ephrata_lf/ephrata_lf_hp.htm.

- **Site Register –** Several types of site-related information are posted in the Site Register, including notice of public comment periods. The Site Register is published bi-monthly and is sent to those who request to be on that particular mailing list. Anyone interested in receiving the Site Register should contact Linda Thompson of Ecology at 360-407-6069 or Ltho461@ecy.wa.gov.

- **Public meetings –** If ten or more people request a meeting during a public comment period, or express a need to better understand the proposed cleanup, Ecology will hold the requested event. Ecology and the PLPs may also choose to hold public meetings if they believe they are needed.

- **Internet –** Ecology's website for the Ephrata Landfill is as follows: http://www.ecy.wa.gov/programs/tcp/sites/ephrata_lf/ephrata_lf_hp.htm. The Agreed Order, Public Participation Plan, and future documents are located on this Web Site.

- **News Releases –** Ecology may issue news releases to local media on major milestones, significant events, and accomplishments as appropriate. News releases may also be provided to Seattle- or Spokane-based media and the Associated Press.

- **Legal Notices –** Paid notices that describe upcoming events and comment opportunities will be published in the *Columbia Basin Herald*, *The Grant County Journal*, and in Spanish in *El Mundo*.

- **Local Information Repository –** All documents related to public comment periods will be available at the repositories below.

  Ephrata City Library
  45 Alder Street NW
  Ephrata, WA 98823

  Department of Ecology
  4601 N. Monroe
  Spokane, WA 99205-1295

  And on Ecology's Web Site at:
  http://www.ecy.wa.gov/programs/tcp/sites/ephrata_lf/ephrata_lf_hp.htm.

- **Ecology Files –** An Ephrata Landfill site file containing all studies and correspondence about the site is kept at Ecology's Eastern Regional Office at the following address:

Department of Ecology
Eastern Regional Office
4601 N. Monroe Street
Spokane, WA 99205

## How Can You Be Sure Your Concerns Are Heard?

- **Comment Periods**—Public comment is invited at each major step in the cleanup.
- **Public Meetings and Workshops**—Ecology will hold public meetings if requested by 10 or more people during each public comment period to discuss and gather input on investigation and cleanup proposals.
- **Written Response to Comments**—Ecology will publish a Responsiveness Summary to comments received during comment periods. The Responsiveness Summary will detail the comments received and provide Ecology's response to each issue.
- **Advocates**—Public interest groups will be invited to review the Responsiveness Summaries before their distribution to ensure the messages are clear.

## Will Technical Assistance Be Provided for Review of Documents?

**Access to Staff**—Ecology has staff available to answer questions on the cleanup process or meet with individuals or groups as requested. Contact Cole Carter at 509/329-3609 if you have questions or would like someone to come speak to your group. Grant County and the City of Ephrata staff are also available to answer questions.

**Public Participation Grants—** Ecology's Solid Waste and Financial Assistance Program can award Public Participation Grants to groups to use for technical assistance in interpreting cleanup documents. Information on Public Participation Grants is available at Ecology's website at the following address: http://www.ecy.wa.gov/biblio/0407011.html.

## Is There a Process for Appeal?

Yes. RCW 70.105D.060 provides for an appeal process. This provision states the only way to challenge Ecology's decisions about a cleanup action is through an action filed in the Superior Court of Thurston County or the county where the cleanup is occurring. The statute allows this type of challenge only under certain circumstances. These circumstances include a citizen suit to compel Ecology to perform a mandated duty that appears to have been neglected. The section also states "the court shall uphold the department's actions unless they were arbitrary and capricious."

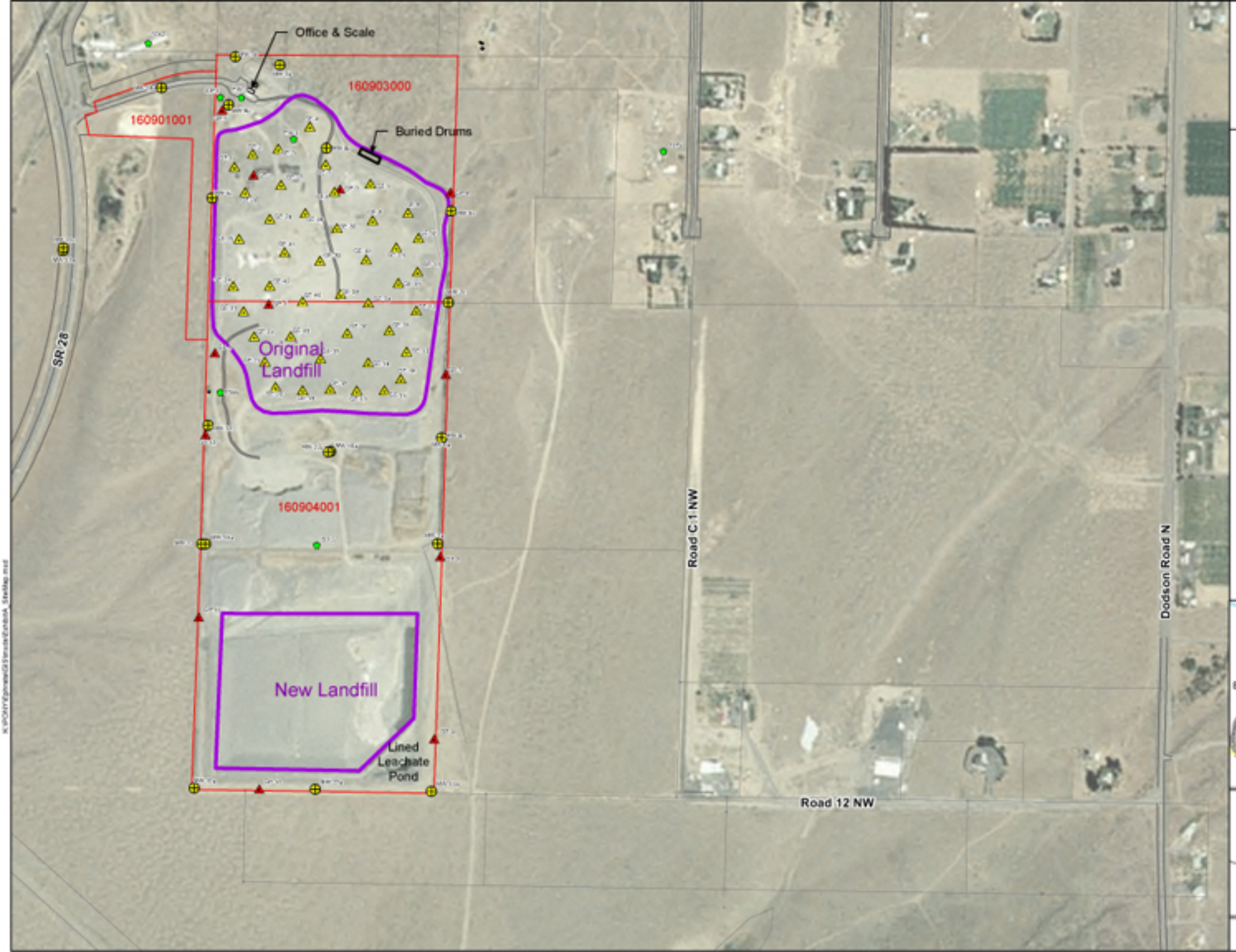
The rationale for the limitations on appeals is based on the hazards caused by fugitive toxic materials. Fugitive toxic materials may cause increased damage to the environment and the people of the State if cleanup action is curtailed for long periods of time to allow for resolving law suits.

## Can This Plan Be Amended?

Ecology views this Plan as a living document that may be improved based on suggestions received from the community. Minor changes in the Plan, such as a suggestions for communicating more effectively with a particular part of the community, may be put into practice without formally amending the Plan.

However, the public participation activities specified for each step in the process will not be reduced without a formal amendment to the Plan. Such an amendment will only be made after an opportunity for public comment.

# Appendix A – Site Map




# Exhibit A
# Ephrata Landfill

Ephrata Landfill

PgG

County Owned Parcels
160901001: Parcel Number
Landfill Extents

Well Type
- Monitoring Well (MW)
- Gas Extraction (GE)
- Gas Probe (GP)
- Other Well

2004 NAIP Orthophoto

N

0 Feet 500

# Chapter 70.105D RCW

# Hazardous waste cleanup — model toxics control act

Complete Chapter

## RCW Sections

## Notes:

Environmental certification programs -- Fees -- Rules -- Liability: RCW 43.21A.175.

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# Appendix C – Mailing List

| Title | First_Name | Last_Name | Company_Name | Other | Number | Street | City | State | Zip |
|---|---|---|---|---|---|---|---|---|---|
| Mr. | Will | Abercrombie | Hart Crowser | | 1910 | E Fairview Ave | Seattle | WA | 98102-3699 |
| Ms. | Deborah | Abrahamson | | | | P. O. Box 61 | Wellpinit | WA | 99040-0061 |
| Ms. | Wanda | Abrahamson | Spokane Tribe of Indians | | 6208 | Ford Wellpinit Road | Spokane | WA | 99040 |
| Mr. and Ms. | Steven L. and Jennifer L. | Adams | | | | P. O. Box 425 | Ephrata | WA | 98823 |
| Mr. and Ms. | Benjamin J. and Jada J. | Addink | | | 444 | Maringo Rd | Ephrata | WA | 98823 |
| Mr. and Ms. | Steven A. and Kerri L. | Adler | | | 12548 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. | Chris C. | Akerblade | | | 740 | W Sunset Dr | Burbank | WA | 99323 |
| Mr. and Ms. | Douglas G. and Kirsten H. | Anderson | | | 2265 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Rubio A. and Antonia D. | Angel | | | 2322 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Earl W. and Marvel L. | Atkins | | | 13043 | Railroad Ave NW | Ephrata | WA | 98823 |
| Mayor | Jim | Baergen | City of Hartline | | | P. O. Box 127 | Hartline | WA | 99135 |
| Mr. and Ms. | Gary W. and Nancy M. | Balentine | | | 2346 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. or Ms. | | Balle | | | 2700 | Rd. 11.7 NW | Ephrata | WA | 98823 |
| Mr. | Rob | Banes | Office of Environmental Health Assessments | Site Assessment Section | | P. O. Box 47846 | Olympia | WA | 98504-7846 |
| Mr. and Ms. | Wayne L. and Gloria J. | Barger | | | 2374 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Reynold and Mable | Barth | | | 27 | Apple Lane | Ephrata | WA | 98823 |
| Mr. | Harold E. | Basso | | | 1126 | Yakima St SE | Ephrata | WA | 98823 |
| Ms. | Harroet | Beale | Puget Sound Action Team | | | P. O. Box 40900 | Olympia | WA | 98504-0900 |
| Ms. | Bonnie | Beavers | Center for Justice | | 35 | W Main St | Spokane | WA | 99201 |
| Mr. | Jim | Bellatty | Department of Ecology | Water Quality Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. and Ms. | Michael And Gayle | Belles | | | 2325 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Mrs. | James and Laura Ann | Bensch | | | 12605 | Rd. C.3 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | James L. and Dorothy A. | Berens | | | 16456 | Rd 1 NW | Quincy | WA | 98848 |
| Ms. | Karin | Berkholtz | Department of Community Development | | | P. O. Box 48300 | Olympia | WA | 98504-8300 |
| Ms. | Tatyana | Bistrevsky | WSU County Extension | | 222 | N Havana | Spokane | WA | 99202-4799 |
| Mr. or Ms. | | Bittle | | | 13391 | Rd. E NW | Ephrata | WA | 98823 |
| Mr. or Ms. | | Black | | | 12995 | Dodson Rd. NW | Ephrata | WA | 98823 |
| Mayor | Katherine | Bohnet | City of Wilson Creek | | | P. O. Box 162 | Wilson Creek | WA | 98860 |
| Mr. | Tim | Bohr | | | 12975 | Rd C.3 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Darrell and Karen | Bolyard | | | | P. O. Box 733 | Ephrata | WA | 98823 |
| Mr. | Art | Bookstrom | US Geological Survey | | 904 | W Riverside Ave, Room 202 | Spokane | WA | 99201-1087 |
| Mr. | Kevin | Booth | Avista | | 1411 | E Mission Msc-21 | Spokane | WA | 99202 |
| Mr. | Jerry | Boyd | Paine Hamblen | | 717 | W Sprague Ave, Ste 1200 | Spokane | WA | 99201-3505 |
| Mr. | Clarence Marvin | Braman | | | 331 | Statter Rd | Ephrata | WA | 98823 |
| Mr. and Ms. | Ermal L. and Reiko | Brandon | | | 12978 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. | Lloyd | Brewer | City of Spokane | Environmental Affairs | 808 | W Spokane Falls Blvd | Spokane | WA | 99201-3333 |
| Ms. | Lisa | Brown | Department of Ecology | Hazardous Waste & Toxics Reduction Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. and Ms. | Terry D. and Debbie K. | Brown | | | 12061 | Dodson Rd | Ephrata | WA | 98823 |
| Mr. and Ms. | Carl D. and Carol J. | Burck | | | 2399 | Basin St SW | Ephrata | WA | 98823 |
| Mr. and Ms. | Loyd And Tami | Burleson II | | | 12948 | Rebecca Ct NW | Ephrata | WA | 98823 |
| Ms. | Janie Marie | Burton | | | | P. O. Box 7731 | Covington | WA | 98042 |
| Mr. or Ms. | | Butcher | | | 2654 | Rd. 11.9 NW | Ephrata | WA | 98823 |
| Mayor | Tammara | Byers | City of Grand Coulee | | | P. O. Box 180 | Grand Coulee | WA | 99133-0180 |
| Hon. | Maria | Cantwell | US Senator | | 920 | W Riverside | Spokane | WA | 99201-1010 |
| Mr. and Mrs. | Scott | Carabaja | | | 12632 | Rd. C.3 NW | Ephrata | WA | 98823 |
| Mayor | Mary Jo | Carey | City of Elmer City | | | P. O. Box 179 | Elmer City | WA | 99124 |
| Ms. | Ann L. | Carrigan | | | 2321 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Salud and Maria | Castillo | | | 12530 | Rd C.5 NW | Ephrata | WA | 98823 |

| Title | First_Name | Last_Name | Company_Name | Other | Number | Street | City | State | Zip |
|---|---|---|---|---|---|---|---|---|---|
| Ms. | Emily | Celto Vache | Department of Ecology | Hazardous Waste & Toxics Reduction Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. | Peter | Christiansen | Department of Ecology | Solid Waste & Financial Assistance Program | 3190 | 160th Avenue SE | Bellevue | WA | 98008-5452 |
| Mr. and Ms. | Robert and Rebecca | Church | | | 8886 | Hillcrest Dr | Moses Lake | WA | 98837 |
| Mr. | Scott | Clark | Grant County | | | P. O. Box 37 | Ephrata | WA | 98823-0037 |
| Mr. and Ms. | Sherman L. and Pamela A. | Clayton | | | 3178 | Rd 12 NW | Ephrata | WA | 98823 |
| Mr. | Wayne | Clifford | Office of Environmental Health Assessments | Site Assessment Section | | P. O. Box 47846 | Olympia | WA | 98504-7846 |
| Mr. | Randy | Connolly | Spokane Tribe of Indians | | | P. O. Box 480 | Wellpinit | WA | 99040 |
| Mayor | Ronald C. | Covey | City of Moses Lake | | | P. O. Box 1579 | Moses lake | WA | 98837 |
| Ms. | Linda | Crerar | Department of Agriculture | | | P. O. Box 42560 | Olympia | WA | 98504-2560 |
| Mr. and Ms. | Robert V. and Shannon M. | Criss | | | 12859 | Rd B.8 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Timothy J. and Lisa A. | Culbertson | | | 20094 | Delta Rd NW | Soap Lake | WA | 98851 |
| Mr. and Ms. | C & S | Dahl | | | 238 | G Street SW | Ephrata | WA | 98823 |
| Ms. | Valerie M. | Dalosto | | | 12221 | 164Th Ave SE | Renton | WA | 98059 |
| Ms. | Laurie | Davies | Department of Ecology | Solid Waste & Financial Assistance Program | | P. O. Box 47775 | Olympia | WA | 98504-7775 |
| Mr. | Chase | Davis | Sierra Club | | 10 | N Post, Ste 447 | Spokane | WA | 99201-0705 |
| Mr. and Ms. | Arthur W. and Grace L. | Dazell | | | | P. O. Box 234 | Ephrata | WA | 98823 |
| Ms. | Cyndy | De Bruler | Columbia Riverkeeper | | | P. O. Box 912 | Bingen | WA | 98605 |
| Mr. | Jim | Degraffenreid | Lincoln County Public Works | | 27234 | SR 25 North | Davenport | WA | 99122 |
| Mr. | Carlos | Diaz | WA State Migrant Council | | 105 | S 6Th Street #B | Sunnyside | WA | 98944 |
| Mr. and Ms. | Steve M. and Paula R. | Dietrich | | | 12860 | Rd B.8 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Harald and Laura | Dilling | | | 2795 | Rd 12.8 NW | Ephrata | WA | 98823 |
| Ms. | Anne | Duffy | WA Department of Health | | | P. O. Box 47825 | Olympia | WA | 98504-7825 |
| Mr. | Andy | Dunau | Lake Roosevelt Forum | | 2206 | S Sherman St | Spokane | WA | 99203 |
| Mr. and Ms. | Cecil E. and Delola M. | Durham | | | | P. O. Box 771 | Ephrata | WA | 98823 |
| | | Editor | Grant County Journal | | 29 | Alder Street SW | Ephrata | WA | 98823 |
| | | Editor | El Mundo | | 10 | N. Mission | Wenatchee | WA | 98807 |
| | | Editor | Columbia Basin Herald | | | P. O. Box 910 | Moses Lake | WA | 98837 |
| | | Editor | Spokesman-Review Local Circulation | | 7770 | Rainier Road NE | Moses Lake | WA | 98837 |
| | | Editor | Escenario Hispano Newspaper | | 813 | W. 3rd Avenue | Moses Lake | WA | 98837 |
| | | Editor | Basin Business Journal | | 815 | W. 3rd Avenue | Moses Lake | WA | 98837 |
| Mayor | Judy K. | Esser | City of Mattawa | | | P. O. Box 965 | Mattawa | WA | 99349 |
| Ms. | Teresa | Eturaspe | Department of Fish and Wildlife | | | P. O. Box 43200 | Olympia | WA | 98504-3155 |
| Mr. and Ms. | Darvin D. and Kathy A. | Fales | | | 12501 | Dodson Rd NW | Ephrata | WA | 98823 |
| Ms. | Cathy | Fallon | | | 839 | Cliff Drive | Spokane | WA | 99204 |
| Mr. or Ms. | | Farer | | | 4022 | Rd. 13.5 NW | Ephrata | WA | 98823 |
| Mr. | Brian | Farmer | Department of Ecology | Shorelines & Environmental Assistance Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. and Ms. | Ernest O. and Heidi K. | Farmer | | | 6663 | Martin Rd NW | Ephrata | WA | 98823 |
| Mr. and Ms. | William J. and Melinda L. | Farmer | | | 4592 | Rd 13.5 NW | Ephrata | WA | 98823 |
| Mr. | Allen | Fiksdal | Energy Facility Site Evaluation Council | | | P. O. Box 43172 | Olympia | WA | 98504-3172 |
| Ms. | Betty | Fowler | Safe Water Coalition of Washington State | | 5615 | W Lyons Ct | Spokane | WA | 99208-3777 |
| Ms. | Darlene | Frye | Department of Ecology | Solid Waste & Financial Assistance Program | 15 | West Yakima Avenue | Yakima | WA | 98902-3387 |
| Mr. | James A. | Frye | | | | P. O. Box 10991 | Yakima | WA | 98909 |
| Mr. | Luz M. | Garcia | | | 2768 | Rd S SW | Quincy | WA | 98848 |
| Ms. | Jani | Gilbert | Department of Ecology | Public Information Officer | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. and Ms. | Daniel E. and Wendy L. | Gilfeather | | | 12886 | Rebecca Ct NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Jerry and Rhonda E. | Gingrich | | | 2435 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Ms. | Jodi L. | Gingrich | | | 31 | Apple Lane | Ephrata | WA | 98823 |
| Ms. | Flora | Goldstein | Department of Ecology | Toxics Cleanup Program | 4601 | North Monroe Street | Spokane | WA | 99205 |

| Title | First_Name | Last_Name | Company_Name | Other | Number | Street | City | State | Zip |
|---|---|---|---|---|---|---|---|---|---|
| Ms. | Lauren H. | Gordon | | | 12944 | Rd B.8 NW | Ephrata | WA | 98823 |
| Mr. | Tom J. | Gray | | | 12592 | Rd C.1 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Bruce L. and Krysta | Gribble | | | 12913 | Rd B.8 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Stephen L. and Sandra L. | Grout | | | 2305 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. | Castaneda | Guillermo | La Clinica Migrant Health Center | | | P. O. Box 1323 | Pasco | WA | 99301-1323 |
| Mr. and Ms. | Kevin L. and Rebecca G. | Guinn | | | 24 | Peachtree Dr | Ephrata | WA | 98823 |
| Mr. | Salud | Gutierrez | | | 12582 | Rd C.5 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Gary and Megan | Hagy | | | 2456 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mayor | Raymond | Halsey | City of Electric City | | | P. O. Box 130 | Electric City | WA | 99123 |
| Mr. and Ms. | James D. and Karen F. | Hand | | | 20922 | SE 270Th St | Covington | WA | 98042 |
| Mr. | Benjamin R. | Hankins | | | 2306 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. | Tom | Hargreaves | The Lands Council | | 129 | W. 16th | Spokane | WA | 99203 |
| Hon. | Doc | Hastings | WA State Representative | | 2715 | St. Andrews Loop Ste D | Pasco | WA | 99301 |
| Mr. | Sanford T. | Hastings | | | 9804 | Mariner Dr NW | Olympia | WA | 98502 |
| Mr. or Ms. | | Hawkins | | | 12329 | Dodson Rd. NW | Ephrata | WA | 98823 |
| Mr. and Ms. | John L. and Nancy | Hawkins Jr | | | | P. O. Box 96 | Ephrata | WA | 98823 |
| Ms. | Jan | Haywood | Department of Health | | | P. O. Box 47820 | Olympia | WA | 98504-7820 |
| Mr. | David L. | Hazzard | | | 4301 | Martin Rd NW | Ephrata | WA | 98823 |
| Mr. | William P. | Helfrich | | | 8599 | Rd 4 NW | Ephrata | WA | 98823 |
| Ms. | Shirley A. | Herr | | | | P. O. Box 304 | Ephrata | WA | 98823 |
| Hon. | Bill | Hinkle | WA State Representative | | | P. O. Box 40600 | Olympia | WA | 98504-0600 |
| Mr. and Ms. | Kevin J. and Geri Lynn | Hinkle | | | 5255 | Painted Hills Rd, #6 | Ephrata | WA | 98823 |
| Mr. or Ms. | | Hinsen | | | 4900 | Rd. 13.5 NW | Ephrata | WA | 98823 |
| Mr. | Jim | Hollingsworth | | | 2508 | Adams Rd | Veradale | WA | 99037 |
| Hon. | Janea | Holmquist | | | | P. O. Box 40413 | Olympia | WA | 98504-0413 |
| Mr. | Thomas | Horne | | | 14626 | Renton/Issaquah Rd | Renton | WA | 98059 |
| Mayor | Wayne R. | Hovde | City of Soap Lake | | | P. O. Box 1270 | Soap lake | WA | 98851 |
| Mr. | Bob | Hubenthal | Department of Social and Health Services | Lands and Building Division | | P. O. Box 45848 | Olympia | WA | 98504-5848 |
| Mr. and Ms. | Thomas and Cynthia K. | Inch | | | 12872 | Rd B.7 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Norman R. and Cheryl A. | Jackson | | | 11987 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mayor | Chris | Jacobson | City of Ephrata | | 121 | Alder Street SW | Ephrata | WA | 98823 |
| Mayor | Justin | Jenks | City of Royal City | | | P. O. Box 1239 | Royal City | WA | 99357 |
| Mr. and Ms. | Darcy J. and Robert J. | Jensen | | | 2424 | Cherry Blossom Lane | Ephrata | WA | 98823 |
| Ms. | Rhonda | Jensen | | | 130 | H St NE | Ephrata | WA | 98823 |
| Mr. | Bill | Jolly | Parks and Recreation Commission | | | P. O. Box 42668 | Olympia | WA | 98504-2668 |
| Mr. and Ms. | Jerry L. and Kellie D. | Kaler | | | 11923 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Michael G. and Sandy Jo | Kallstrom | | | | P. O. Box 155 | Ephrata | WA | 98823 |
| Mr. or Ms. | | Kibby | | | 2086 | Rd. 11.9 NW | Ephrata | WA | 98823 |
| Ms. | Vivian Peterson | Kirkevold | | | | P. O. Box 210215 | Auke Bay | AK | 99821 |
| Mr. and Ms. | Gerald and Elizabeth | Klein | | | 12385 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Paul and Karrie | Klingeman | | | 12867 | Rebecca Ct NW | Ephrata | WA | 98823 |
| Mayor | Elliot | Kooy | City of George | | | P. O. Box 5277 | George | WA | 98824 |
| Mr. | James | Layman | Inland Northwest Wildlife Council | | 6116 | N Market St | Spokane | WA | 99207 |
| Dr. | Hugh | Lefcort | Gonzaga University | | 502 | E Boone | Spokane | WA | 99258 |
| Mr. | Keith | Lenssen | | | 13836 | Rd C.4 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Larry D. and Janet A. | Lenssen | | | 13836 | Rd C.4 NW | Ephrata | WA | 98823 |
| Mr. | John C | Linder | | | 11969 | Dodson Rd NW | Ephrata | WA | 98823 |
| Ms. | Karen | Lindheldt | Center for Justice | | 35 | W Main, Ste 300 | Spokane | WA | 99201 |

| Title | First_Name | Last_Name | Company_Name | Other | Number | Street | City | State | Zip |
|---|---|---|---|---|---|---|---|---|---|
| Mr. | Robert M. | Lowy | TDP Roberts Corporation | | 1014 | W. 16th Avenue | Spokane | WA | 99203 |
| Mr. | Tom | Luce | | | 4121 | N Standard | Spokane | WA | 99207 |
| Mr. | Michael G. | Lufkin | Marten Law Group | | 1191 | Second Avenue, Suite 2200 | Seattle | WA | 98101 |
| Ms. | Joyce | Manship | | | 12660 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Darral E. and Barbara A. | Manthey | | | 2304 | Plum St | Ephrata | WA | 98823 |
| Mr. and Ms. | Robert and Mary | Mantz | | | 4388 | Rd. 13.5 NW | Ephrata | WA | 98823 |
| Mr. | Paul | Markham | | | | P. O. Box 2251 | Hailey | ID | 83303 |
| Mr. and Ms. | Eduardo and Martha | Martinez | | | 224 | J St NE | Ephrata | WA | 98823 |
| Ms. | Patricia J. Hooper | Martinez | | | 740 | Fairbanks Dr | Moses Lake | WA | 98837 |
| Mr. and Ms. | Clayton J. and Leona | Massey | | | 12313 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Kraig M. and Rosa M. | Massey | | | 3230 | Rd 12.8 NW | Ephrata | WA | 98823 |
| Ms. | Rosa | Massey | | | 3230 | Rd. 12.8 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Hector and Dalia | Matus | | | 3202 | Rd 5 NW #1 | Ephrata | WA | 98823 |
| Mr. | Billy W. | Mc Anulty Et.Al. | | | | P. O. Box 33 | Ephrata | WA | 98823 |
| Mr. and Ms. | Jeffrey A. and Laura L. | Mc Cracken | | | 3060 | Rd 12 NW | Ephrata | WA | 98823 |
| Mr. | James F. | Mc Donnell | | | 11997 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. or Ms. | | McMillan | | | 2661 | Rd. 12.8 NW | Ephrata | WA | 98823 |
| Mr/ | Larry Scott | Miller | | | 2441 | Basin St SW | Ephrata | WA | 98823 |
| Ms. | Terri | Miller | Department of Ecology | Shorelines & Environmental Assistance Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. and Ms. | Patrick R. And Judy G. | Molitor | | | 4121 | Peninsula Dr | Moses Lake | WA | 98837 |
| Mr. and Ms. | Clint & Anne | Moore | | | 4503 | SR 28 | Ephrata | WA | 98823 |
| Mr. and Ms. | Clinton and Anna Belle | Moore | | | | P. O. Box 2 | Ephrata | WA | 98823 |
| Ms. | Martha | Morales | | | 12582 | Rd. C.5 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Robert L. and Marie E. | Morrison | | | 11977 | Dodson Rd | Ephrata | WA | 98823 |
| Mr. and Ms. | Robert and Peggy | Muchlinski | | | 2266 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Ms. | Leslie C. | Nellermoe | Heller Ehrman | | 701 | Fifth Avenue, Suite 6100 | Seattle | WA | 98104-7098 |
| Mr. and Ms. | Dale S. and Carol S. | Nelson | | | 1075 | Basin St SW | Ephrata | WA | 98823 |
| Mr. and Ms. | Robert A. and Yvonne | Nichols | | | 2290 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Fedor A. and Vera V. | Novikov | | | 10138 | Linden Rd NW | Soap Lake | WA | 98851 |
| Mr. and Ms. | Victor and Hortencia | Olivares | | | 12637 | Rd C.5 NW | Ephrata | WA | 98823 |
| Ms. | Carol D. | Olsen | | | 2339 | Plum St | Ephrata | WA | 98823 |
| Mr. or Ms. | | Olson | | | 620 | Rd. B.7 NW | Ephrata | WA | 98823 |
| Dr. | John | Osborn | | | 2421 | W Mission | Spokane | WA | 99201 |
| Mr. and Ms. | Leonid and Elena | Pashkovsky | | | 12679 | Rd C.5 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Nikolay and Ludmilla | Pashkovsky | | | 12596 | Rd C.3 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Vladimir and Lydmila | Pashkovsky | | | 12731 | Rd C.5 NW | Ephrata | WA | 98823 |
| Ms. | Larena | Perez | | | | P. O. Box 1285 | Ephrata | WA | 98823 |
| Mr. | Rodney R. | Peters | | | | P. O. Box 73 | Ephrata | WA | 98823 |
| Mr. | Mike | Peterson | The Lands Council | | 423 | W First, Ste 240 | Spokane | WA | 99201 |
| Mr. | Grant | Pfeifer | Department of Ecology | Eastern Regional Office Director | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. | Darryl | Piercy | Kittitas County | | 411 | North Ruby Street #2 | Ellensburg | WA | 98926 |
| Mr. and Ms. | Leroy and Barbara | Pinney | | | 22 | Apple Lane | Ephrata | WA | 98823 |
| Ms. | Teila | Plaaster | | | 3354 | 12.8 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Thomas C. and Judith L. | Potter | | | 30 | Apple Lane | Ephrata | WA | 98823 |
| Mr. and Ms. | Everett W. and Tracy J. | Purrington | | | 12947 | Rd B.8 NW | Ephrata | WA | 98823 |
| Ms. | Linda | Razey | | | 3354 | Rd. 12.8 NW | Ephrata | WA | 98823 |
| Ms. | Angela | Reife | | | 3158 | Rd. 12.8 NW | Ephrata | WA | 98823 |
| | | Resident | | | 11923 | B Dodson Rd. NW | Ephrata | WA | 98823 |

| Title | First_Name | Last_Name | Company_Name | Other | Number | Street | City | State | Zip |
|---|---|---|---|---|---|---|---|---|---|
| | | Resident | | | 11239 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11275 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11397 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11443 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11586 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11589 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11617 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11751 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11823 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 11987 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12009 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12259 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12345 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12439 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12483 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12545 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12689 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 12997 | Dodson Rd. NW | Ephrata | WA | 98823 |
| | | Resident | | | 13065 | Railroad Ave. | Ephrata | WA | 98823 |
| | | Resident | | | 11449 | Rd. 11.3 NW | Ephrata | WA | 98823 |
| | | Resident | | | 4392 | Rd. 13.5 NW | Ephrata | WA | 98823 |
| | | Resident | | | 4712 | Rd. 13.5 NW | Ephrata | WA | 98823 |
| | | Resident | | | 4844 | Rd. 13.5 NW | Ephrata | WA | 98823 |
| | | Resident | | | 12936 | Rd. B.6 NW | Ephrata | WA | 98823 |
| | | Resident | | | 12873 | Rd. B.7 NW | Ephrata | WA | 98823 |
| | | Resident | | | 12924 | Rd. B.7 NW | Ephrata | WA | 98823 |
| | | Resident | | | 12925 | Rd. B.7 NW | Ephrata | WA | 98823 |
| | | Resident | | | 12936 | Rd. B.7 NW | Ephrata | WA | 98823 |
| | | Resident | | | 12939 | Rd. B.7 NW | Ephrata | WA | 98823 |
| | | Resident | | | 12632 | Rd. C NW | Ephrata | WA | 98823 |
| | | Resident | | | 13019 | Rd. E NW | Ephrata | WA | 98823 |
| | | Resident | | | 13175 | Rd. E NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Alvin and Sherry | Richardson | | | 2371 | Basin St SW | Ephrata | WA | 98823 |
| Mr. and Ms. | Larry A. and Diane M. | Riebli | | | 3277 | Rd 12.9 NW | Ephrata | WA | 98823 |
| Ms. | Barbara | Ritchie | Department of Ecology | Environmental Review | | P. O. Box 47703 | Olympia | WA | 98504-7703 |
| Ms. | Carol Lee | Roalkvam | Department of Transportation | | | P. O. Box 47330 | Olympia | WA | 98504-7330 |
| Mr. and Ms. | Bradley G. and Amy J. | Rodman | | | 8 | Apple Lane | Ephrata | WA | 98823 |
| Mr. and Ms. | Dewey R. and Barbara S. | Rogers Jr | | | | P. O. Box 1325 | Ephrata | WA | 98823 |
| Mr. and Ms. | Michael D. and Jennifer | Roland | | | | P. O. Box 1166 | Ephrata | WA | 98823 |
| Mr. | Mike | Roland | | | 3553 | Rd. 12.8 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Andrew J. and Angela H. | Rolfe | | | 3158 | Rd 12.8 NW | Ephrata | WA | 98823 |
| Mr. | Russell | Romig | | | 247 | J St NE, Apt. J | Ephrata | WA | 98823 |
| Mr. | Albert D. | Rosellini | | | 5936 | 6Th Ave S | Seattle | WA | 98108 |
| Mr. or Ms. | D. | Rostel | | | 11911 | Dodson Rd. NW | Ephrata | WA | 98823 |
| Mr. | Kirk A. | Sager | | | 5431 | Rd 11.7 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Vicente and Raquel | Sanchez Jr. | | | 12912 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Thomas Dean and Donna L. | Scheelke | | | 2338 | Cherry Blossom Lane | Ephrata | WA | 98823 |
| Mr. and Ms. | Harvy A. and Bonnie L. | Schuch | | | 8 | Peachtree Dr | Ephrata | WA | 98823 |

| Title | First_Name | Last_Name | Company_Name | Other | Number | Street | City | State | Zip |
|---|---|---|---|---|---|---|---|---|---|
| Mr. and Ms. | Gary D. and Cindy L. | Sell | | | 2455 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Ronald P. and Michiko | Sell And Garcia | | | 1224 | D St SW | Ephrata | WA | 98823 |
| Mr. and Ms. | Mark D. and Sue Ellen | Sherwood | | | 7 | Apple Lane | Ephrata | WA | 98823 |
| Ms. | Christina | Shields | | | 2408 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. | Etalvadim | Shipovskiy | | | 521 | Glenmoor Dr | Moses Lake | WA | 98837 |
| Ms. | Kay | Shirey | Office of the Attorney General | Ecology Division | | P. O. Box 40117 | Olympia | WA | 98504-0117 |
| Mr. and Ms. | Edward and Louise A. | Sivula | | | 12574 | Rd C.1 NW | Ephrata | WA | 98823 |
| Ms. | Amy Jo | Smith | | | 12574 | Rd C.3 NW | Ephrata | WA | 98823 |
| Mr. | Ronald D. | Smith | | | 20807 | Pacific Hwy 103 | Ocean Park | WA | 98640 |
| Mr. and Ms. | Steven D. and Deborah C. | Smith | | | | P. O. Box 537 | Ephrata | WA | 98823 |
| Mr. and Ms. | Dale E. and Donna J. | Smith | | | 12887 | Rebecca Ct NW | Ephrata | WA | 98823 |
| Ms. | Nora D. | Snider | | | | P. O. Box 33 | Ephrata | WA | 98823 |
| Mayor | Quincy | Snow | City of Coulee Dam | | 300 | Lincoln Ave | Coulee Dam | WA | 99116 |
| Mr. and Ms. | Thomas W. and Pamela S. | Sortomme | | | 368 | 3rd Ave SE | Ephrata | WA | 98823 |
| Mr. and Ms. | Jeff and Kelli | Spencer | | | 12720 | Dodson Rd NW | Ephrata | WA | 98823 |
| Mr. and Ms. | David J. and Joyce E. | Spencer | | | 1250 | Sage Rd | Ephrata | WA | 98823 |
| | | Stecker | | | 11355 | Dodson Rd. NW | Ephrata | WA | 98823 |
| Mr. | Mark | Stephens | Department of Ecology | Spills Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. | Cullen | Stephenson | Department of Ecology | Solid Waste & Financial Assistance Program | 300 | Desmond Drive | Lacey | WA | 98504-7600 |
| Mr. and Ms. | Edwin C. and Edith N. | Stocker | | | 63 | Lincoln Ave | Snohomish | WA | 98290 |
| Mr. | Keith | Stoffel | Department of Ecology | Water Resources Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. and Ms. | Randall W. and Sabrina | Strong | | | 60 | Peachtree Dr | Ephrata | WA | 98823 |
| Ms. | Nicky | Swanson | Department of Ecology | Hazardous Waste & Toxics Reduction Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. and Ms. | Allan C. and Diane K. | Swensen | | | 12687 | Dodson Rd N | Ephrata | WA | 98823 |
| Mr. | Jim | Tiffany | Editor, El Mundo Newspaper | | | P. O. Box 2231 | Wenatchee | WA | 98807 |
| Mr. and Ms. | Terrance and Leslie | Trachsler | | | | P. O. Box 207 | Ephrata | WA | 98823 |
| Ms. | Joanna S. | Tupling | | | 38 | Peachtree Dr | Ephrata | WA | 98823 |
| Mr. | Michael J. | Uhl, ETAL | | | 4077 | Highway 28 W | Ephrata | WA | 98823 |
| Mr. | Jesus R. | Vega | | | 15 | Mt View Dr | Quincy | WA | 98848 |
| Ms. | Halah | Voges | The Retec Group, Inc. | | 1011 | SW Klickitat Way, Suite 207 | Seattle | WA | 98134-1162 |
| Ms. | Amber | Waldref | The Lands Council | | 423 | W 1 Street, #240 | Spokane | WA | 99201 |
| Mr. | Calvin J. | Walker | | | | P. O. Box 842 | Ephrata | WA | 98823 |
| Hon. | Judy | Warnick | WA State Representative | | | P. O. Box 40600 | Olympia | WA | 98504-0600 |
| Mr. and Ms. | Donald L. and Karin D. | Webster | | | 333 | Brickyard Pt Rd N | Beaufort | SC | 29907 |
| Mr. and Ms. | Larry A. and Debbie M. | Weis | | | 2337 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Joseph M. and Linda J. | White | | | | P. O. Box 1145 | Ephrata | WA | 98823 |
| Dr. | Robert | Whitlam | Office of Archaeology and Historic Preservation | | | P. O. Box 48343 | Olympia | WA | 98504-8343 |
| | | Whitmans | | | 2156 | Rd. 11.9 NW | Ephrata | WA | 98823 |
| Mr. and Ms. | Ronald L. and Evelyn | Wilkinson | | | 2289 | Cherry Blossom Dr | Ephrata | WA | 98823 |
| Mr. and Ms. | Gary R. and Christine R. | Williamson | | | 13511 | E 54Th Dr | Yuma | AZ | 85367 |
| Mr. | Loren | Wiltse | Adams County | | 165 | North 1st Ave | Olympia | WA | 99344-1065 |
| Mr. and Ms. | Rock R. and Cynthia | Witte | | | | P. O. Box 1153 | Ephrata | WA | 98823 |
| Mr. and Ms. | Thomas B. and Terri L. | Witte | | | 9589 | Rd I.5 NE | Ephrata | WA | 98823 |
| | | Wolen | | | 11879 | Dodson Rd. NW | Ephrata | WA | 98823 |
| Ms. | Karen | Wood | Department of Ecology | Air Quality Program | 4601 | North Monroe Street | Spokane | WA | 99205 |
| Mr. | Colton James | Wright | | | | P. O. Box 294 | Oroville | WA | 98844 |
| Mr. and Ms. | Ronald D. and Shelley M. | Yenney | | | 8278 | Martin Rd NW | Ephrata | WA | 98823 |
| Mayor | Dick | Zimbelman | City of Quincy | | | City Hall | Quincy | WA | 98848 |

| Title | First_Name | Last_Name | Company_Name | Other | Number | Street | City | State | Zip |
|---|---|---|---|---|---|---|---|---|---|
| Mr. and Ms. | William and Delanas | Zimbelman | | | 12695 | Rd C.1 NW | Ephrata | WA | 98823 |
| | | | Hopp Family Limited Ptrn | | 13612 | 122Nd Ave E | Puyallup | WA | 98374 |
| | | | Oasis Park RV and Golf | | 2541 | Basin Street Southwest | Ephrata | WA | 98823 |
| | | | Sunwest Park LLC | | 2233 | California Ave SW | Seattle | WA | 98116 |
| | | | Washington St Wildlife Dept | | 600 | Capitol Way N GJ-11 | Olympia | WA | 98501 |
| | | | Grant County Public Works | | 124 | Enterprise St SE | Ephrata | WA | 98823 |
| | | | Apparatus Repair & Welding | | 4301 | Martin Rd. | Ephrata | WA | 98823 |
| | | | US Fish & Wildlife Service | | 2315 | N. Discovery Pl | Spokane Valley | WA | 99216 |
| | | | Country Boys Inc | | | P. O. Box 115 | Ephrata | WA | 98823 |
| | | | Consolidated Disposal Service | | | P. O. Box 1154 | Ephrata | WA | 98823 |
| | | | Madrona East Mhp LLC | | | P. O. Box 22637 | Seattle | WA | 98122 |
| | | | Basin Estates LP | | | P. O. Box 2444 | Gig Harbor | WA | 98335 |
| Mayor | | | City of Warden | | | P. O. Box 428 | Warden | WA | 98857 |
| | | | Department of Natural Resources | SEPA Center | | P. O. Box 47015 | Olympia | WA | 98504-7015 |
| | | | P U D #2 Grant County | | | P. O. Box 878 | Ephrata | WA | 98823 |
| | | | Pheasant Land Company, LLC | | 19474 | Rd B NW | Soap Lake | WA | 98851 |
| | | | Orchard View Homes LLC | | 13836 | Rd C.4 NW | Ephrata | WA | 98823 |
| | | | U.S. EPA Region 10 (HW 117) | Community Relations | 1200 | Sixth Avenue | Seattle | WA | 98101-3188 |
| | | | Aspi Group | | 5200 | Southcenter Blvd #100 | Tukwila | WA | 98188 |

# Appendix D – Glossary of Terms

# APPENDIX D
# GLOSSARY

**Agreed Order:** A legal document issued by Ecology which formalizes an agreement between the department and potentially liable persons (PLPs) for the actions needed at a site. An agreed order is subject to public comment. If an order is substantially changed, an additional comment period is provided.

**Applicable State and Federal Law:** All legally applicable requirements and those requirements that Ecology determines are relevant and appropriate requirements.

**Area Background:** The concentrations of hazardous substances that are consistently present in the environment in the vicinity of a site which are the result of human activities unrelated to releases from that site.

**Carcinogen:** Any substance or agent that produces or tends to produce cancer in humans.

**Chronic Toxicity:** The ability of a hazardous substance to cause injury or death to an organism resulting from repeated or constant exposure to the hazardous substance over an extended period of time.

**Cleanup:** The implementation of a cleanup action or interim action.

**Cleanup Action:** Any remedial action, except interim actions, taken at a site to eliminate, render less toxic, stabilize, contain, immobilize, isolate, treat, destroy, or remove a hazardous substance that complies with cleanup levels; utilizes permanent solutions to the maximum extent practicable; and includes adequate monitoring to ensure the effectiveness of the cleanup action.

**Cleanup Action Plan:** A document which identifies the cleanup action and specifies cleanup standards and other requirements for a particular site. After completion of a comment period on a Draft Cleanup Action Plan, Ecology will issue a final Cleanup Action Plan.

**Cleanup Level:** The concentration of a hazardous substance in soil, water, air or sediment that is determined to be protective of human health and the environment under specified exposure conditions.

**Cleanup Process:** The process for identifying, investigating, and cleaning up hazardous waste sites.

**Consent Decree:** A legal document approved and issued by a court which formalizes an agreement reached between the state and potentially liable persons (PLPs) on the actions

needed at a site. A decree is subject to public comment. If a decree is substantially changed, an additional comment period is provided.

**Containment:** A container, vessel, barrier, or structure, whether natural or constructed, which confines a hazardous substance within a defined boundary and prevents or minimizes its release into the environment.

**Contaminant:** Any hazardous substance that does not occur naturally or occurs at greater than natural background levels.

**Enforcement Order:** A legal document, issued by Ecology, requiring remedial action. Failure to comply with an enforcement order may result in substantial liability for costs and penalties. An enforcement order is subject to public comment. If an enforcement order is substantially changed, an additional comment period is provided.

**Environment:** Any plant, animal, natural resource, surface water (including underlying sediments), ground water, drinking water supply, land surface (including tidelands and shorelands) or subsurface strata, or ambient air within the state of Washington.

**Exposure:** Subjection of an organism to the action, influence or effect of a hazardous substance (chemical agent) or physical agent.

**Exposure Pathways:** The path a hazardous substance takes or could take form a source to an exposed organism. An exposure pathway describes the mechanism by which an individual or population is exposed or has the potential to be exposed to hazardous substances at or originating from the site. Each exposure pathway includes an actual or potential source or release from a source, an exposure point, and an exposure route. If the source exposure point differs from the source of the hazardous substance, exposure pathway also includes a transport/exposure medium.

**Facility:** Any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly-owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, vessel, or aircraft; or any site or area where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed or, placed, or otherwise come to be located.

**Feasibility Study (FS):** A study to evaluate alternative cleanup actions for a site. A comment period on the draft report is required. Ecology selects the preferred alternative after reviewing those documents.

**Free Product:** A hazardous substance that is present as a nonaqueous phase liquid (that is, liquid not dissolved in water).

**Groundwater:** Water found beneath the earth's surface that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater occurs in sufficient quantities that it can be used for drinking water, irrigation, and other purposes.

**Hazardous Sites List:** A list of sites identified by Ecology that requires further remedial action. The sites are ranked from 1 to 5 to indicate their relative priority for further action.

**Hazardous Substance:** Any dangerous or extremely hazardous waste as defined in RCW 70.105.010 (5) (any discarded, useless, unwanted, or abandoned substances including, but not limited to, certain pesticides, or any residues or containers of such substances which are disposed of in such quantity or concentration as to pose a substantial present or potential hazard to human health, wildlife, or the environment because such wastes or constituents or combinations of such wastes; (a) have short-lived, toxic properties that may cause death, injury, or illness or have mutagenic, teratogenic, or carcinogenic properties; or (b) are corrosive, explosive, flammable, or may generate pressure through decomposition or other means,) and (6) (any dangerous waste which (a) will persist in a hazardous form for several years or more at a disposal site and which in its persistent form presents a significant environmental hazard and may affect the genetic makeup of man or wildlife; and is highly toxic to man or wildlife; (b) if disposed of at a disposal site in such quantities as would present an extreme hazard to man or the environment), or any dangerous or extremely dangerous waste as designated by rule under Chapter 70.105 RCW: any hazardous substance as defined in RCW 70.105.010 (14) (any liquid, solid, gas, or sludge, including any material, substance, product, commodity, or waste, regardless of quantity, that exhibits any of the characteristics or criteria of hazardous waste as described in rules adopted under this chapter,) or any hazardous substance as defined by rule under Chapter 70.105 RCW; petroleum products.

**Hazardous Waste Site:** Any facility where there has been a confirmation of a release or threatened release of a hazardous substance that requires remedial action.

**Independent Cleanup Action:** Any remedial action conducted without Ecology oversight or approval, and not under an order or decree.

**Initial Investigation:** An investigation to determine that a release or threatened release may have occurred that warrants further action.

**Interim Action:** Any remedial action that partially addresses the cleanup of a site.

**Mixed Funding:** Any funding, either in the form of a loan or a contribution, provided to potentially liable persons from the state toxics control account.

**Model Toxics Control Act (MTCA):** Washington State's law that governs the investigation, evaluation and cleanup of hazardous waste sites. Refers to RCW 70.105D. It was approved by voters at the November 1988 general election and known is as Initiative 97. The implementing regulation is WAC 173-340.

**Monitoring Wells:** Special wells drilled at specific locations on or off a hazardous waste site where groundwater can be sampled at selected depths and studied to determine the direction of groundwater flow and the types and amounts of contaminants present.

**Natural Background:** The concentration of hazardous substance consistently present in the environment which has not been influenced by localized human activities.

**National Priorities List (NPL):** EPA's list of hazardous waste sites identified for possible long-term remedial response with funding from the federal Superfund trust fund.

**Owner or Operator:** Any person with any ownership interest in the facility or who exercises any control over the facility; or in the case of an abandoned facility, any person who had owned or operated or exercised control over the facility any time before its abandonment.

**Polynuclear Aromatic Hydrocarbon (PAH):** A class of organic compounds, some of which are long-lasting and carcinogenic. These compounds are formed from the combustion of organic material and are ubiquitous in the environment. PAHs are commonly formed by forest fires and by the combustion of fossil fuels.

**Potentially Liable Party:** see Potentially Liable Person.

**Potentially Liable Person (PLP):** Any person whom Ecology finds, based on credible evidence, to be liable under authority of RCW 70.105D.040.

**Public Notice:** At a minimum, adequate notice mailed to all persons who have made a timely request of Ecology and to persons residing in the potentially affected vicinity of the proposed action; mailed to appropriate news media; published in the local (city or county) newspaper of largest circulation; and opportunity for interested persons to comment.

**Public Participation Plan:** A plan prepared under the authority of WAC 173-340-600 to encourage coordinated and effective public involvement tailored to the public's needs at a particular site.

**Recovery By-Products:** Any hazardous substance, water, sludge, or other materials collected in the free product removal process in response to a release from an underground storage tank.

**Release:** Any intentional or unintentional entry of any hazardous substance into the environment, including, but not limited to, the abandonment or disposal of containers of hazardous substances.

**Remedial Action:** Any action to identify, eliminate, or minimize any threat posed by hazardous substances to human health or the environment, including any investigative and monitoring activities of any release or threatened release of a hazardous substance and any health assessments or health effects studies.

**Remedial Investigation (RI):** A study to define the extent of problems at a site. When combined with a study to evaluate alternative cleanup actions it is referred to as a Remedial Investigation/Feasibility Study (RI/FS). In both cases, a comment period on the draft report is required.

**Responsiveness Summary:** A compilation of all questions and comments to a document open for public comment and their respective answers/replies by Ecology. The Responsiveness Summary is mailed, at a minimum, to those who provided comments and its availability is published in the Site Register.

**Risk Assessment:** The determination of the probability that a hazardous substance, when released into the environment, will cause an adverse effect in exposed humans or other living organisms.

**Sensitive Environment:** An area of particular environmental value, where a release could pose a greater threat than in other areas including: wetlands; critical habitat for endangered or threatened species; national or state wildlife refuge; critical habitat, breeding or feeding area for fish or shellfish; wild or scenic river; rookery; riparian area; big game winter range.

**Site:** See Facility.

**Site Characterization Report:** A written report describing the site and nature of a release from an underground storage tank, as described in WAC 173-340-450 (4) (b).

**Site Hazard Assessment (SHA):** An assessment to gather information about a site to confirm whether a release has occurred and to enable Ecology to evaluate the relative potential hazard posed by the release. If further action is needed, an RI/FS is undertaken.

**Site Register:** Publication issued every two weeks of major activities conducted statewide related to the study and cleanup of hazardous waste sites under the Model Toxics Control Act. To receive this publication, please call (360) 407-7200.

**Surface Water:** Lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the state of Washington or under the jurisdiction of the state of Washington.

**TCP:** Toxics Cleanup Program at Ecology

**Total Petroleum Hydrocarbons (TPH):** A scientific measure of the sum of all petroleum hydrocarbons in a sample (without distinguishing one hydrocarbon from another). The "petroleum hydrocarbons" include compounds of carbon and hydrogen that are derived from naturally occurring petroleum sources or from manufactured petroleum products (such as refined oil, coal, and asphalt).

**Toxicity:** The degree to which a substance at a particular concentration is capable of causing harm to living organisms, including people, plants and animals.

**Underground Storage Tank (UST):** An underground storage tank and connected underground piping as defined in the rules adopted under Chapter 90.76 RCW.

**Washington Ranking Method (WARM):** Method used to rank sites placed on the hazardous sites list. A report describing this method is available from Ecology.

# Quality Assurance Project Plan
# Ephrata Landfill Drum Area Exploration
# Ephrata, Washington

*Prepared for*

**Grant County Department of Public Works**

*and*

**City of Ephrata**

*Prepared by*

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February 2007 | 555-1860-011 (03/05)

## CITATION

Parametrix. 2007. Quality Assurance Project Plan/Ephrata Landfill Drum Area Exploration Ephrata, Washington. Prepared by Parametrix, Bellevue, Washington. February 2007.

# APPROVALS

## Quality Assurance Project Plan for Ephrata Landfill Drum Area Assessment

| | |
|---|---|
| Derek Pohle, P.E.<br>Public Works Director/County Engineer<br>Project Coordinator<br>Grant County | Date |
| Wes Crago<br>City Administrator<br>Project Coordinator<br>City of Ephrata | Date |
| Brian Pippin, P.E.<br>Project Manager<br>Parametrix | Date |
| John Hicks<br>Subconsultant Project Manager<br>Engineering/Remediation Resources Group (ERRG) | Date |
| Cole Carter<br>Site Manager/Project Coordinator<br>Ecology | Date |

# DISTRIBUTION LIST

| Name | Organization |
|---|---|
| Cole Carter | Ecology |
| Derek Pohle | Grant County |
| Wes Crago | City of Ephrata |
| Leslie Nellermoe | HellerEhrman |
| Mike Lufkin | Marten Law Group PLLC |
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| Lara Linde | Parametrix |
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| Scott Elkind | Parametrix |
| John Hicks | ERRG |
| Tracy Smith | ERRG |
| Halah Voges | RETEC |
| Jim Schneider | RETEC |
| Charles (Pony) Ellingson | Pacific Groundwater Group |
| Dawn Chapel | Pacific Groundwater Group |

# TABLE OF CONTENTS

# ACRONYMS

| | |
|---|---|
| CW | Containerized Waste |
| FW | Free Flowing Waste |
| Ecology | Washington State Department of Ecology |
| EPA | Environmental Protection Agency |
| ERRG | Engineering/Remediation Resources Group |
| HAZWOPER | Hazardous Waste Operation |
| ID | inside diameter |
| IRAP | Interim Remedial Action Plan Ephrata Landfill Corrective Action |
| PCBs | Polychlorinated Biphenyls |
| PDF | portable document format |
| PQL | Practical Quantitation Limit |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RCRA | Resource Conservation Recovery Act |
| STL | Severn Trent Laboratory |
| SVOCs | Semi-volatile Organic Compounds |
| TCLP | Toxicity Characteristics Leaching Procedure |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compound |

# 1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) supports surveying and sampling of buried drums located at the Ephrata Landfill in Ephrata, Washington (Figure 1-1). These activities comprise one of several interim actions described in the Interim Remedial Action Plan Ephrata Landfill Corrective Action (IRAP) (Parametrix 2006), which is Exhibit C of Agreed Order No. DE 3810 between Washington State Department of Ecology (Ecology) and Grant County and the City of Ephrata (Ecology 2006) (Agreed Order). Grant County has requested Parametrix and Engineering/Remediation Resources Group (ERRG) to survey and sample drums to obtain data needed to complete drum removal project planning and refine drum removal specifications. Drum removal will be accomplished as a separate interim action.

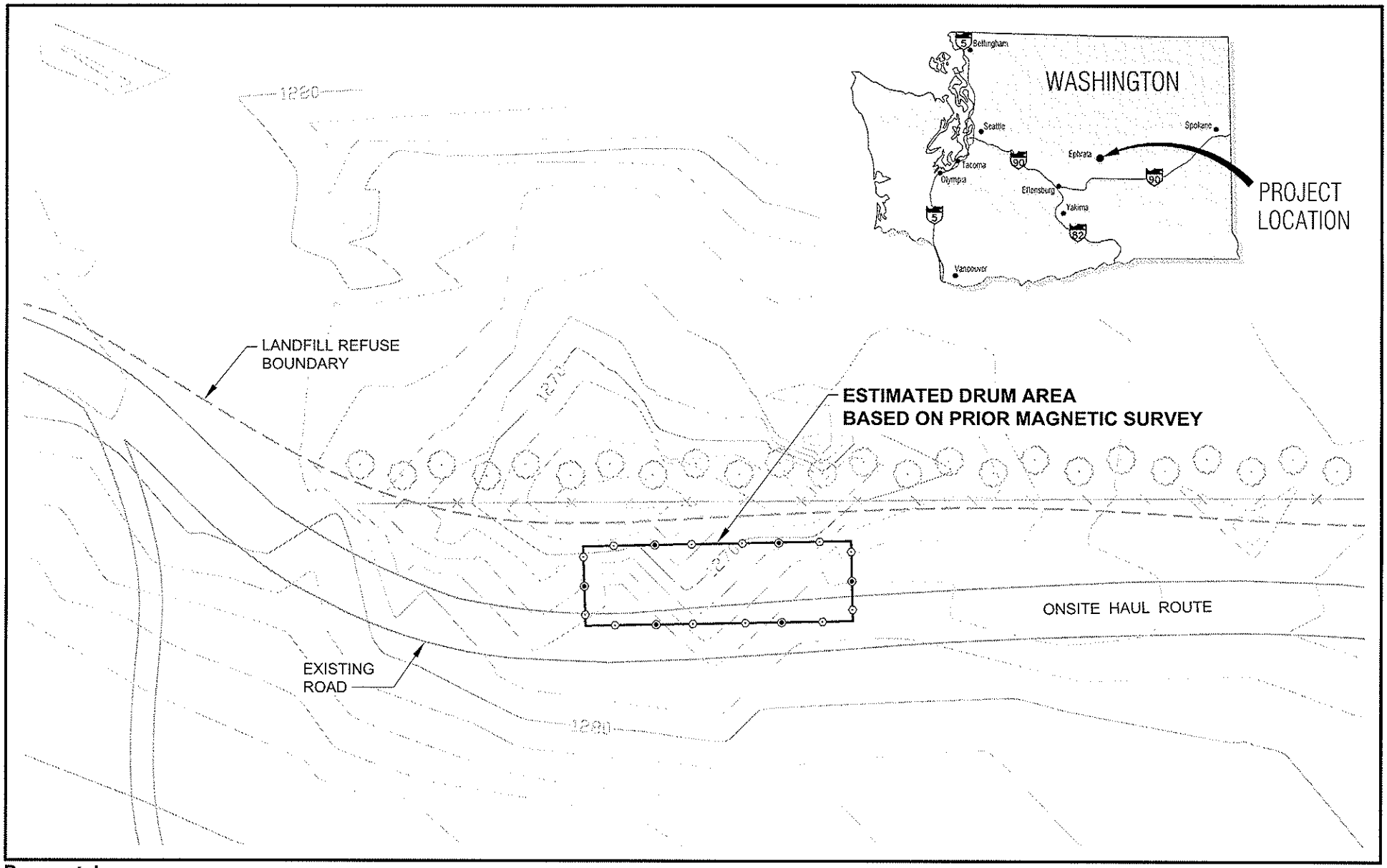
Parametrix and ERRG prepared this QAPP consistent with Ecology and U.S. Environmental Protection Agency (EPA) requirements found in the following documents:

- Ecology Model Toxics Control Act (Ecology 2001).
- EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans, Final, March 2001.
- EPA QA/G-5, EPA Guidance for Quality Assurance Project Plans, December 2002.

This QAPP reflects a level of detail and completeness appropriate for waste sampling and analysis consistent with the graded approach described in the above EPA documents.

## 1.1 PROJECT BACKGROUND

Grant County, with concurrence from Ecology and the City of Ephrata, solicited bids in August 2006 for buried drum removal. The parties anticipated, at that time, that the Agreed Order would be finalized and the public comment period closed prior to the start of drum removal site activities. For various reasons, all bids were rejected and drum removal did not proceed. Bidders had submitted an unusually large number of questions during drum removal advertisement. Bidder questions focused on uncertainties about the drum contents and attendant worker health and safety issues, analytical costs, and disposal requirements. Surveying and sampling drums will provide data needed to complete drum removal planning and refine drum removal specifications to more clearly allocate drum removal project risks and responsibilities.




Parametrix DATE: Jan 15, 2007 FILE: BR1860011P03T05-F-01

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0 60'

SCALE IN FEET

**LEGEND**

- ◉ DRUM SAMPLE AND SURVEY LOCATION
- ⊙ DRUM SURVEY LOCATION

**Figure 1-1**
**Ephrata Landfill Drum Removal**
**Drum Exploration and**
**Sampling Locations**

# 2. PROJECT ORGANIZATION AND MANAGEMENT

This section describes project organization and management including a project description, background of the site, project roles and responsibilities, documentation, and reporting requirements.

## 2.1 PROJECT ORGANIZATION

Drum area exploration project roles are summarized in Table 2-1.

**Table 2-1. Project Roles and Responsibilities**

| Person | Function | Organization | Phone | Key Project Role |
|---|---|---|---|---|
| Cole Carter | Site Manager, Project Coordinator | Ecology | (509) 329-3609 | Regulatory oversight and approvals |
| Derek Pohle | Project Coordinator | Grant County | (509) 754-6082 | Owner's representative, point of contact for approvals |
| Wes Crago | Project Coordinator | City of Ephrata | (509) 754-4601 | Point of contact for approvals |
| Brian Pippin | Project Manager | Parametrix | (425) 458-6370 | Technical and administrative lead |
| Jeremy Krohn | Field Lead | Parametrix | (425) 458-6283 | Field coordination, ambient air monitoring, project documentation |
| Sheila McConnell | Certified Industrial Hygienist | Parametrix | (425) 452-8655<br>(425) 681-7516 | Off-site health and safety support for Parametrix & ERRG |
| John Hicks | Subconsultant Project Manager | ERRG | (206) 423-7784 | Subconsultant technical and administrative lead |
| Tracy Smith | Field Lead | ERRG | (253) 606-5489 | Field coordination, sample collection and handling, project documentation |
| Kathy Kreps | Analytical Laboratory | Severn-Trent Laboratory (STL) | (253) 922-2310 | Laboratory analyses and reporting |

## 2.2 PROBLEM DEFINITION/BACKGROUND

The purpose of the drum area exploration interim action is to survey and sample drums to obtain data needed to complete drum removal planning and refine drum removal specifications. This action is not anticipated to substantively affect the decision to remove the drums.

Documentation of the drum placement is limited. The drums are thought to have been placed in the mid 1970's, stacked in three layers on top of bedrock (basalt). The exact number, contents, and condition of the drums are unknown (Ecology 1987). The approximate location of drums has been identified through geophysical exploration (Pacific Groundwater Group 2004). There have been no other investigations or sampling of the drums.

## 2.3 TASK DESCRIPTION

Excavate test pits or trenches (18 planned) to corroborate geophysical exploration findings, by surveying drum coordinates and depths, and analyze drum content samples (6 planned). Surveying, sampling, and analysis will be conducted as described in Section 3.0.

## 2.4 SPECIAL TRAINING AND CERTIFICATION

All personnel conducting sampling activities on the project site must be 40-hour Hazardous Waste Operation (HAZWOPER) trained per 29CFR 1910.120 and be current with their annual 8-hour refresher course.

Staff sampling the drums will have appropriate training and equipment for Level B consistent with the health and safety plan entitled Health and Safety Plan for Ephrata Landfill Drum Exploration Investigation (ERRG/Parametrix 2007).

## 2.5 SAMPLING DOCUMENTATION AND RECORDS

Sample handling will be documented through the use of daily field logs, photographs, and other documents as appropriate.

### 2.5.1 Field Logs and Forms

A bound field notebook will be maintained to provide daily records of field activities and observations. Entries will be made in waterproof ink, signed, and dated. Notebook pages will not be removed or destroyed. Corrections will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. Corrections will be initialed and dated. Explanatory footnotes will be included as appropriate. To the extent feasible errors will be corrected or corrections initialed by the person who made the original entry. Upon completion of the exploration, field logs and forms will be retained in the project files.

### 2.5.2 Photographs

Photographs will be noted and cross-referenced in the field notebook. Digital photographs will be reviewed in the field to assess quality and need to re-shoot the photograph. Non-digital photographs will be reviewed once developed. Photographs will be matched and reconciled with notebook entries.

## 2.6 REPORTING

Following completion of sampling and analysis, Parametrix will prepare a short technical report including the following:

- Summary of field activities completed
- Figures showing sampling locations
- Survey data
- Summary of laboratory analytical results and comparison to relevant regulatory criteria
- Boring/test pit logs and sampling forms
- Laboratory data sheets and the results of data review

A draft report will be submitted to Ecology electronically in portable document format (PDF) and in Microsoft Word format. Two hard copies, electronic and compact disc instances of the final report reflecting response to Ecology comments will be submitted.

# 3. DATA GENERATION AND ACQUISITION

This section discusses the specific rationale used to develop sampling and analysis strategies.

## 3.1 SAMPLING PROCESS DESIGN

The subsurface investigation will include a drum area perimeter evaluation and waste characterization from selected locations in the drum area.

The objective of the drum area perimeter evaluation is to obtain the coordinates and depths of several perimeter drums. The data will be used to complete drum removal plans and specifications. Material above the drums (overburden) is expected to be municipal solid waste and crushed rock/gravel. It is unlikely that any leakage from drums would have contaminated overburden; therefore, overburden will not be sampled. Since the overburden is not considered to be contaminated it will be disposed of as refuse in the active landfill. The excavations will be backfilled with onsite borrow.

The objective of the drum sampling is to obtain waste characterization data to facilitate disposal options. Samples of drum contents will be collected, and the chemical nature of the collected material will be evaluated using the laboratory methods described in Section 3.4 of this QAPP. Proposed sampling includes:

- Collecting 6 drum samples from the 18 test pits (see Figure 1-1). The pits will be completed to the top of the drums to obtain representative samples of the drum contents.
- Additional sampling based on field observations of drum stability.

Test pits for drum sampling will be located at the east and west boundaries of the geophysical anomaly and at appropriate distances between (see Figure 1-1). Specific test pit locations will be determined in the field and surveyed. A description of the proposed sampling methods is presented in Section 3.2.

## 3.2 SAMPLING METHODS AND PROCEDURES

This section presents the sampling methods and procedures to be used to collect data necessary to adequately characterize representative drum contents at the site. The contents of the drums are unknown but should fit within the categories of liquid (aqueous or organic), sludge or solid. For the purposes of this study, a sample is defined as an aliquot or representative grab from the entire depth of the drum.

### 3.2.1 Drum Content Sampling

Drums will be accessed using tools such as a bung wrench. In the case of corrosion or poor access to the open top or bung of the drum, a cold cut will be made with an oversized drill bit or saw blade. If solids are encountered during sampling, a larger hole will be cut to allow sub-sampling of the solid material. Drum cuts, where needed, will be made using non-sparking, intrinsically safe tools.

Representative samples will be collected from the drum contents at six locations using disposable drum samplers consisting of pre-cleaned, ½-inch inside diameter (ID), glass tubes. The drum sampling tube will be inserted into the drum, to the full depth. The top of the tube will be sealed and removed from the drum. Observations of the percentage of liquid and sludge, and other physical characteristics will be collected. The samples will then be placed

directly into labeled sampling containers provided by the analytical laboratory, as described in the following paragraphs.

After sampling, the drum entry point will be sealed with an expandable rubber stopper seal or similar, to prevent the contents from leaking, since the sampled drums will remain in place.

If the sample appears to be mostly liquid, a minimum of four 500 mL jars/sample (2 liters) and two 40mL Volatile Organic Analysis (VOA) vials (for Volatile Organic Compound (VOC) analysis) will be collected and submitted to the laboratory in sampling kits marked "aqueous samples." In the case that the material appears to be an oil or thick liquid, only two 500 mL jars/sample (1 liter) and two 40mL VOA vials of drum material will be collected (see Table 3-1).

If the drum contains mostly solids or heavy sludges, and the material is unable to be withdrawn using the glass tube, a pre-cleaned stainless steel spatula or corer will be used to remove a sample from the drum. Sufficient solid material to fill two wide-mouth 500 mL jars and two 2 oz. wide mouth glass jars for 8260 VOC analysis will be collected.

Multi-phase material (liquid and solid) may also be encountered in some of the drums. Drum contents of this nature will require a minimum of two liters of sample, plus two 40 mL VOA vials for volatile analysis.

Each test pit will be logged by the Field Leads or designees. Logs will include general material descriptions and photos as appropriate.

Drum coordinates and elevations will be ascertained using conventional land survey methods, with accuracy to the nearest 0.1 foot.

### 3.2.2 Sampling Containers, Preservation, and Holding Times

A summary of specifications for containers, preservation and holding times for drum samples are shown in Table 3-1.

**Table 3-1. Sample Containers, Preparation, Preservatives and Holding Times for Drum Sampling**

| Sample Matrix | Analyses | Method | Sample Container | Preservation and Handling | Holding Times |
|---|---|---|---|---|---|
| Liquid and Multiphase | VOCs | EPA 8260B | (2) 40 ml VOA vials | Zero headspace, cool to 4°C | 14 days |
| | Flashpoint | EPA 1020A | (4) 500 ml glass jars with PTFE lined lids[1] | Cool to 4°C | - |
| | Reactive Cyanide | EPA 9014 | | | 7 days |
| | Sulfide | EPA 9034 | | | 7 days |
| | pH | EPA 9045C | | | 7 days |
| | PCBs | EPA 8082 | | | 7 days |
| | SVOCs | EPA 8270C | | | 7 days |
| | RCRA Metals (8) | EPA 6010/7470A | | | 6 months<br>Hg 28 days |
| | Pesticides | EPA 8081A | | | 7 days |
| | Herbicides | EPA 8151A | | | 7 days |

**Table 3-1. Sample Containers, Preparation, Preservatives and Holding Times for Drum Sampling (continued)**

| Sample Matrix | Analyses | Method | Sample Container | Preservation and Handling | Holding Times |
|---|---|---|---|---|---|
| Sludge and Solids | VOCs | EPA 8260B | (2) 2 oz. Wide Mouth glass jars with PTFE lined lids | Zero headspace, cool to 4°C | 14 days |
| | Flashpoint | EPA 1020A | (4) 500 ml glass jars with PTFE lined lids | Cool to 4°C | - |
| | Reactive Cyanide | EPA 9014 | | | 7 days |
| | Sulfide | EPA 9034 | | | 7 days |
| | pH | EPA 9045C | | | 7 days |
| | PCBs | EPA 8082 | | | 7 days |
| | TCLP RCRA Metals (8) | EPA 1311/ 6010/7470A | | | 7 days |
| | TCLP Pesticides | EPA 1311/ 8081A | | | 7 days |
| | TCLP Herbicides | EPA 1311/ 8151A | | | 7 days |
| | TCLP VOCs | EPA 1311/ 8260B | | | 7 days |
| | TCLP SVOCs | EPA 1311/ 8270C | | | 7 days |

[1] Unless oil or thick liquid then (2) 500 ml glass jars

### 3.2.3 Decontamination Procedures

Decontamination of all non-disposable tools and equipment will be conducted between each sampling location. The following steps will be taken during decontamination of hand-held equipment and tools used during field investigations:

- Scrub with non-phosphate detergent (i.e., Alconox or similar).
- Rinse with tap water.
- Rinse thoroughly with deionized water.
- Allow to air dry and place in clean Ziploc bag or other clean container.

Larger tools and equipment, such as the excavator bucket, will be brushed off and washed if needed at the end of the project as described in the site health and safety plan (ERRG/Parametrix 2007). Between test pits, loose soil materials will be scraped or brushed off of equipment Further information regarding decontamination procedures can be found in the site health and safety plan.

### 3.2.4 Investigation-Derived Waste

Investigation-derived waste will be stored in drums labeled with the date, content, location, company, and a unique identification number. Disposable supplies and personal protective equipment (i.e., disposable coveralls, gloves, paper towels) cross-contaminated by drum contents will be placed inside polyethylene bags or other appropriate containers. Cross-contaminated supplies will be designated for disposal. Uncontaminated disposable supplies will be segregated for disposal as ordinary solid waste. Material excavated from the test pits will be placed in the active landfill cell onsite.

## 3.3 SAMPLE HANDLING AND CUSTODY

This section describes protocols for sample labeling, packaging and transportation, and sample chain-of-custody to be used for this project. These procedures ensure that the quality and integrity of the samples are maintained during their collection, transportation, storage, and analysis.

For ease in completing the chain-of-custody, a list of requested analyses will be included with the sample shipment and attached to the chain-of-custody.

### 3.3.1 Sample Identification and Labeling

Prior to the field investigation, each sample location will be assigned a unique code. Each sample collected at that location will be pre-assigned an identification code using the sampling site code followed by other specific information describing the sample. The sample numbering protocol is shown in Table 3-2.

**Table 3-2. Sample Numbering Protocol**

| | |
|---|---|
| Classification | CW = Containerized Waste<br>FW = Free Flowing Waste |
| Sampling Station | Sampling location number |
| Date | MMDDYY |

The following example illustrates the sample numbering system:

CW-01-021107, where:

| | | |
|---|---|---|
| CW | = | Waste encountered is containerized |
| 01 | = | Sampling Station Number #1 |
| 021107 | = | February 11, 2007 |

### 3.3.2 Sample Storage, Packing, and Transportation

Samples will be placed in a cooler following collection and chilled to approximately 4ºC using wet ice. Samples will be transported or shipped to the analytical laboratory within a timeframe consistent with the sample holding times shown in Table 3-1.

Samples will be accumulated onsite and delivered to the lab in one batch. If prolonged cooler storage is necessary, additional wet ice will be added to ensure that cooler temperatures remain at approximately 4ºC.

### 3.3.3 Sample Custody

The chain-of-custody procedures used for this project provide an accurate written or computerized record that can be used to trace the possession of each sample from the time each is collected until the completion of all required analyses. A sample is in custody if it is in any of the following places:

- In someone's physical possession
- In someone's view
- In a secured container
- In a designated secure area

The following information will be provided on the chain-of-custody form:

- Sample identification numbers
- Matrix type for each sample
- Analytical methods to be performed for each sample
- Number of containers for each sample
- Sampling date and time for each sample
- Names of sampling personnel
- Signature and dates indicating the transfer of sample custody

For ease in completing the chain-of-custody, a list of requested analyses will be included with the sample shipment and attached to the chain-of-custody.

All samples will be maintained in custody until formally transferred to the laboratory under a written chain-of-custody. Samples will be kept in sight of the sampling crew or in a secure, locked vehicle at all times. Samples that leave the custody of field personnel will be sealed by placing a signed and dated Custody Seal across the seam of the shipping container.

## 3.4 ANALYTICAL METHODS

Drum samples will be analyzed for waste characterization purposes. The sample volume and container protocols described in Section 3.2 above were suggested by the laboratory to support the waste analyses described below. The default project laboratory will be Severn Trent Laboratories (STL) in Tacoma, Washington. The laboratory name may change during this project due to a recent merger of the Severn Trent and TestAmerica laboratory divisions, however, the Ecology accreditation will not be affected. The following analyses are planned:

- Flashpoint (Setaflash Closed Cup) using EPA Method 1020A.
- Toxicity Characteristics Leaching Procedure (TCLP) Resource Conservation Recovery Act (RCRA) 8 Metals using EPA Method 1311/6010B/7470A.
- TCLP Organochlorine Pesticides by EPA Method 1311/8081A.
- TCLP Chlorinated Herbicides by EPA Method 1311/8151A.
- TCLP VOCs by EPA Method 1311/ 8260B.
- TCLP Semi-volatile Organic Compounds (SVOCs) by EPA Method 1311/8270C.

- Reactive Cyanide by EPA Method 9014.
- Sulfide by EPA Method 9034.
- pH by EPA Method 9045C.
- Polychlorinated Biphenyls (PCBs) by EPA Method 8082.
- Samples will be tested for full list VOCs by EPA Method 8260B.

A list of analytes for each of the TCLP analyses shown above is included in Appendix A.

If drum samples appear to be single phase aqueous material, the following analyses are planned in lieu of the TCLP analyses:

- VOCs by EPA Method 8260B.
- SVOCs by EPA Method 8270C.
- RCRA 8 Metals using EPA Method 6010B/7470A.
- Organochlorine Pesticides by EPA Method 8081A.
- Chlorinated Herbicides by EPA Method 8151A.

Analytical methods and quantitation limits for the analytes are presented in Appendix B. The reporting limit in most cases is equal to the Practical Quantitation Limit (PQL), or the lowest concentration that can be reliably measured during routine laboratory operating conditions, using Ecology-approved analysis methods. The laboratory will notify the Project Manager of any proposed procedural changes and document these changes in the cover letter with the data reports.

No field quality control samples are planned for this project due to the nature of the material (waste) and the intent of this investigation.

### 3.4.1 Field Data

Originals of field notes and laboratory reports will be stored in the project files. Field notes will be recorded in bound notebooks or forms substantively like those included in Appendix B.

### 3.4.2 Laboratory Data

A summary and internal laboratory quality control results will be included in the laboratory data reports and archived in the project files. Electronic data will be in the form of portable document format (PDF) and may be incorporated into spreadsheets and archived on electronic media and placed in the project file.

# 4. DATA REVIEW

This section describes procedures for assessing project data. The Project Managers or their designees will review the following Quality Control (QC) data results for all samples:

- Chain-of-custody documentation
- Holding times
- Analyses requested were performed
- Laboratory method blank evaluation
- Surrogate and matrix spike recovery evaluation

If, based on this limited review, the QC data results indicate potential data quality problems, further evaluations will be conducted.

# 5. REFERENCES

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# APPENDIX A

## STL Reporting Limits Spreadsheet

SEVERN TRENT STL

Severn Trent Laboratories, Inc.
5755 8th Street East
Tacoma, WA 98424

**Prepared for:**

John Hicks
ERRG
1910 Fairview Ave. East, Suite 103
Seattle, WA 98102

| | |
|---|---|
| Prepared by | Kreps, Kathy E |
| Date | 10/13/2006, Revised 11/3/06 |
| Expiration Date | 1/12/2007 |
| Est. Start Date | |

*Project: Waste Characterization*

*Quote Number: 58001098*

| Matrix | Method | Test Description | Analyte | RL | MDL | Units |
|---|---|---|---|---|---|---|
| **Waste Characterization** | | | | | | |
| Waste | 1020A | Setaflash Closed-Cup Method of Determining Ignitability | Flashpoint | NONE | NONE | NONE |
| Waste | 6010B (1311 - 3010A) | Inductively Coupled Plasma - Atomic Emission Spectrometry | Lead | 0.015 | 0.00117 | mg/L |
| | | | Arsenic | 0.05 | 0.0027 | mg/L |
| | | | Barium | 0.005 | 0.00016 | mg/L |
| | | | Cadmium | 0.005 | 0.00011 | mg/L |
| | | | Chromium | 0.01 | 0.00063 | mg/L |
| | | | Selenium | 0.05 | 0.00442 | mg/L |
| | | | Silver | 0.01 | 0.00083 | mg/L |
| Waste | 7470A (1311 - 7470A) | Mercury in Liquid Waste (Manual Cold Vapor Technique) | Mercury | 0.0002 | 5.5E-05 | mg/L |
| Waste | 8081A (1311 - 3510C) | Organochlorine Pesticides by Gas Chromatography | gamma-BHC (Lindane) | 0.001 | 0.00010 | mg/L |
| | | | Chlordane (technical) | 0.01 | 0.00173 | mg/L |
| | | | Endrin | 0.002 | 0.00028 | mg/L |
| | | | Heptachlor | 0.001 | 0.00028 | mg/L |
| | | | Heptachlor epoxide | 0.001 | 0.00014 | mg/L |
| | | | Methoxychlor | 0.01 | 0.00132 | mg/L |
| | | | Toxaphene | 0.1 | 0.00925 | mg/L |
| Waste | 8151A (1311 - 8151A) | Chlorinated Herbicides by GC-MS | 2,4-D | 0.025 | 0.00115 | ug/L |
| | | | Silvex (2,4,5-TP) | 0.025 | 0.00208 | ug/L |
| Waste | 8260B (1311 - 5030B) | Volatile Organic Compounds by GC/MS | Vinyl chloride | 1 | 0.18 | ug/L |
| | | | 1,1-Dichloroethene | 1 | 0.098 | ug/L |
| | | | 2-Butanone | 5 | 1.2 | ug/L |
| | | | Chloroform | 1 | 0.067 | ug/L |
| | | | Carbon tetrachloride | 1 | 0.07 | ug/L |
| | | | Benzene | 1 | 0.1 | ug/L |
| | | | 1,2-Dichloroethane | 1 | 0.2 | ug/L |
| | | | Trichloroethene | 1 | 0.074 | ug/L |
| | | | Tetrachloroethene | 1 | 0.088 | ug/L |

SEVERN TRENT STL

Severn Trent Laboratories, Inc.
5755 8th Street East
Tacoma, WA 98424

**Prepared for:**

John Hicks
ERRG
1910 Fairview Ave. East, Suite 103
Seattle, WA 98102

Prepared by: Kreps, Kathy E
Date: 10/13/2006, Revised 11/3/06
Expiration Date: 1/12/2007
Est. Start Date:

*Project: Waste Characterization*

*Quote Number: 58001098*

| Matrix | Method | Test Description | Analyte | RL | MDL | Units |
|---|---|---|---|---|---|---|
| | | | Chlorobenzene | 1 | 0.063 | ug/L |
| Waste | 8270C (1311 - 3510C) | Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) | 1,4-Dichlorobenzene | 2 | 0.12 | ug/L |
| | | | 2-Methylphenol | 2 | 0.38 | ug/L |
| | | | 3 & 4 Methylphenol | 4 | 0.17 | ug/L |
| | | | Hexachloroethane | 3 | 0.13 | ug/L |
| | | | Nitrobenzene | 2 | 0.075 | ug/L |
| | | | Hexachlorobutadiene | 3 | 0.16 | ug/L |
| | | | 2,4,6-Trichlorophenol | 3 | 0.1 | ug/L |
| | | | 2,4,5-Trichlorophenol | 2 | 0.085 | ug/L |
| | | | 2,4-Dinitrotoluene | 2 | 0.12 | ug/L |
| | | | Hexachlorobenzene | 2 | 0.082 | ug/L |
| | | | Pentachlorophenol | 3.5 | 0.13 | ug/L |
| | | | Pyridine | 10 | 1.2 | ug/L |
| Waste | 9014 (7.3.3) | Reactive Cyanide Analysis using method 9014 | Cyanide, Reactive | 20 | 20 | mg/Kg |
| Waste | 9034 (7.3.4) | Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides | Sulfide | 20 | 20 | mg/Kg |
| | | | Sulfide, Reactive | 20 | 20 | mg/Kg |
| Waste | 9045C | Soil and Waste pH | pH | NONE | NONE | NONE |
| **F-listed Solvents** | | | | | | |
| Waste | 8260B (5035) | Volatile Organic Compounds by GC/MS | Trichlorofluoromethane | 40 | 3.8 | ug/Kg |
| | | | 1,1-Dichloroethene | 16 | 5.3 | ug/Kg |
| | | | 1,1,2-Trichloro-1,2,2-trifluoroethane | 40 | 3 | ug/Kg |
| | | | Carbon disulfide | 40 | 5 | ug/Kg |
| | | | Acetone | 200 | 29 | ug/Kg |
| | | | Methylene Chloride | 40 | 6.1 | ug/Kg |
| | | | Methyl Ethyl Ketone | 200 | 55 | ug/Kg |
| | | | 1,1,1-Trichloroethane | 16 | 3.9 | ug/Kg |
| | | | Carbon tetrachloride | 16 | 3 | ug/Kg |
| | | | Benzene | 8 | 2.8 | ug/Kg |

Severn Trent Laboratories, Inc.
5755 8th Street East
Tacoma, WA 98424

**Prepared for:**

John Hicks
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1910 Fairview Ave. East, Suite 103
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| | |
|---|---|
| Prepared by | Kreps, Kathy E |
| Date | 10/13/2006, Revised 11/3/06 |
| Expiration Date | 1/12/2007 |
| Est. Start Date | |

*Project: Waste Characterization*

*Quote Number: 58001098*

| Matrix | Method | Test Description | Analyte | RL | MDL | Units |
|---|---|---|---|---|---|---|
| | | | n-Butyl alcohol | 4000 | 510 | ug/Kg |
| | | | Trichloroethene | 16 | 3 | ug/Kg |
| | | | methyl isobutyl ketone | 200 | 12 | ug/Kg |
| | | | Toluene | 40 | 7.4 | ug/Kg |
| | | | 1,1,2-Trichloroethane | 40 | 3.6 | ug/Kg |
| | | | Tetrachloroethene | 25 | 7.3 | ug/Kg |
| | | | Chlorobenzene | 40 | 12 | ug/Kg |
| | | | Ethylbenzene | 40 | 7.2 | ug/Kg |
| | | | m-Xylene & p-Xylene | 40 | 15 | ug/Kg |
| | | | o-Xylene | 40 | 7.2 | ug/Kg |
| | | | 1,2-Dichlorobenzene | 40 | 3.4 | ug/Kg |
| | | | Ethyl ether | 200 | 12 | ug/Kg |
| | | | Ethyl acetate | 200 | 21 | ug/Kg |
| Waste | 8270C (3580A) | Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) | 2-Methylphenol | 100 | 28 | ug/Kg |
| | | | 3 & 4 Methylphenol | 200 | 53 | ug/Kg |
| | | | Nitrobenzene | 100 | 15 | ug/Kg |
| | | | Pyridine | 1000 | 250 | ug/Kg |
| | | | Cyclohexanone | 300 | 100 | ug/Kg |
| **PCBs** | | | | | | |
| Waste | 8082 (3580A) | Polychlorinated Biphenyls (PCBs) by Gas Chromatography | PCB-1016 | 0.01 | 0.0058 | mg/Kg |
| | | | PCB-1221 | 0.01 | 0.0058 | mg/Kg |
| | | | PCB-1232 | 0.01 | 0.0058 | mg/Kg |
| | | | PCB-1242 | 0.01 | 0.0058 | mg/Kg |
| | | | PCB-1248 | 0.01 | 0.0058 | mg/Kg |
| | | | PCB-1254 | 0.01 | 0.0015 | mg/Kg |
| | | | PCB-1260 | 0.01 | 0.0015 | mg/Kg |
| **Table 4** | | | | | | |
| Water | 160.1 | Total Dissolved Solids | Total Dissolved Solids | 20 | 20 | mg/L |
| Water | 300 | Chloride & Sulfate | Chloride | 0.4 | 0.13 | mg/L |
| | | | Sulfate | 0.3 | 0.036 | mg/L |

SEVERN TRENT STL

Severn Trent Laboratories, Inc.
5755 8th Street East
Tacoma, WA 98424

**Prepared for:**

John Hicks
ERRG
1910 Fairview Ave. East, Suite 103
Seattle, WA 98102

| | |
|---|---|
| Prepared by | Kreps, Kathy E |
| Date | 10/13/2006, Revised 11/3/06 |
| Expiration Date | 1/12/2007 |
| Est. Start Date | |

*Project: Waste Characterization*

*Quote Number: 58001098*

| Matrix | Method | Test Description | Analyte | RL | MDL | Units |
|---|---|---|---|---|---|---|
| Water | 300 | Nitrate | Nitrogen, Nitrate | 0.03 | 0.011 | mg/L |
| Water | 6010B (3005A) | Metals (Custom List) | Iron | 0.2 | 0.0148 | mg/L |
| Water | 6020 (3005A) | ICP-MS | Arsenic | 0.002 | 0.000367 | mg/L |
| | | | Manganese | 0.002 | 0.0000477 | mg/L |
| Water | 8260B (5030B) | VOC | Chloromethane | 1 | 0.18 | ug/L |
| | | | Vinyl chloride | 1 | 0.18 | ug/L |
| | | | Chloroethane | 5 | 0.19 | ug/L |
| | | | Trichlorofluoromethane | 1 | 0.088 | ug/L |
| | | | 1,1-Dichloroethene | 1 | 0.098 | ug/L |
| | | | Methylene Chloride | 1 | 0.09 | ug/L |
| | | | trans-1,2-Dichloroethene | 1 | 0.074 | ug/L |
| | | | 1,1-Dichloroethane | 1 | 0.11 | ug/L |
| | | | cis-1,2-Dichloroethene | 1 | 0.079 | ug/L |
| | | | Benzene | 1 | 0.1 | ug/L |
| | | | 1,2-Dichloroethane | 1 | 0.2 | ug/L |
| | | | Trichloroethene | 1 | 0.074 | ug/L |
| | | | 1,2-Dichloropropane | 1 | 0.092 | ug/L |
| | | | Toluene | 1 | 0.066 | ug/L |
| | | | Tetrachloroethene | 1 | 0.088 | ug/L |
| | | | Ethylbenzene | 1 | 0.085 | ug/L |
| | | | m-Xylene & p-Xylene | 2 | 0.17 | ug/L |
| | | | o-Xylene | 1 | 0.068 | ug/L |
| | | | 1,4-Dichlorobenzene | 1 | 0.052 | ug/L |
| | | | 1,2-Dichlorobenzene | 1 | 0.07 | ug/L |
| Water | 8270C (3510C) | SVOC | Bis(2-ethylhexyl) phthalate | 15 | 0.32 | ug/L |

# APPENDIX B

## Example Field Forms

**STL Seattle**
5755 8th Street East

Tacoma, WA 98484
phone 253-922-2310 fax 253-922-5047

# Chain of Custody Record

SEVERN TRENT STL

**Severn Trent Laboratories, Inc.**

| **Client Contact** | **Project Manager:** | **Site Contact:** | **Date:** | COC No: |
|---|---|---|---|---|
| ERRG | **Tel/Fax:** | **Lab Contact:** | **Carrier:** | _____ of _____ COCs |
| 1910 Fairview Ave E Suite 103 | **Analysis Turnaround Time** | | | Job No. |
| Seattle, WA 98102 | Calendar ( C ) or Work Days (W) _____ | | | |
| (206) 423-7784 Phone | TAT if different from Below _____ | | | SDG No. |
| (206) 212-2194 FAX | ☐ 2 weeks | | | |
| Project Name:Ephrata Landfill Drum Exploration | ☐ 1 week | | | |
| Site: | ☐ 2 days | | | |
| P O # | ☐ 1 day | | | |

| **Sample Identification** | **Sample Date** | **Sample Time** | **Sample Type** | **Matrix** | **# of Cont.** | Filtered Sample | Sample Specific Notes: |
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**Preservation Used: 1= Ice, 2= HCl; 3= $H_2SO_4$; 4=$HNO_3$; 5=NaOH; 6= Other** _____

***Possible Hazard Identification***

☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown*

***Sample Disposal ( A fee may be assessed if samples are retained longer than 1 month)***

☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* _____ *Months*

**Special Instructions/QC Requirements & Comments:**

| Relinquished by: | Company: | Date/Time: | Received by: | Company: | Date/Time: |
|---|---|---|---|---|---|
| Relinquished by: | Company: | Date/Time: | Received by: | Company: | Date/Time: |
| Relinquished by: | Company: | Date/Time: | Received by: | Company: | Date/Time: |

Date:
Time: _____
Weather: _____
Page: _____
Project Number: _____
Project: _____

# TRENCHING LOG

PROJECT NAME _____
TRENCHING CONTRACTOR _____
TRENCHING EQUIPMENT _____
SITE / SAMPLE LOCATION _____
SAMPLE MATRIX _____
SAMPLE NUMBER _____
SAMPLE DEPTH _____
DEPTH TO GROUNDWATER _____

| CONTAINERS USED | AMOUNT COLLECTED |
|---|---|
| | |
| | |
| | |
| | |

COMMENTS/OBSERVATIONS: _____

SOIL DESCRIPTION/GROUNDWATER PARAMETERS: _____

TRENCH LOCATION MAP:

| | | | | | | | | | | | |
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PREPARED BY: _____

Date:
Time: _____
Weather: _____
Page: _____
Project Number: _____
Project: _____

TRENCH CROSS-SECTION SKETCH:

ADDITIONAL COMMENTS/OBSERVATIONS _____

_____

_____

PREPARED BY: _____

# Engineering/Remediation Resources Group, Inc.
# Nonconformance Report

Project Number: _____ Report Number: _____

Project Name: _____

Nonconformance Description:

_____

_____

_____

_____

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_____

_____

_____

Prepared By: _____ Date: _____

Corrective Action Taken:

_____

_____

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_____

Prepared By: _____ Date: _____

Corrective Action Verification:

_____

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Verified By: _____ Date: _____

PACIFIC groundwater GROUP

# FINAL SAMPLING ANALYSIS AND QUALITY ASSURANCE PROJECT PLAN REMEDIAL INVESTIGATION (TASK 3 AND TASK 4) INVESTIGATION OF SOURCE AND EXTENT OF GROUNDWATER CONTAMINATION EPHRATA LANDFILL CORRECTIVE ACTION

**AUGUST 2007**

# FINAL SAMPLING ANALYSIS AND QUALITY ASSURANCE PROJECT PLAN REMEDIAL INVESTIGATION (TASK 3 AND TASK 4) INVESTIGATION OF SOURCE AND EXTENT OF GROUNDWATER CONTAMINATION EPHRATA LANDFILL CORRECTIVE ACTION

*Prepared for:*

**Grant County**
**Department of Public Works**
**P.O. Box 37**
**Ephrata, Washington 98823-0037**
**and**
**City of Ephrata**
**121 Alder Street**
**Ephrata, WA 98823**

*Prepared by:*

**Pacific Groundwater Group**
**2377 Eastlake Avenue East, Suite 200**
**Seattle, Washington 98102**
**206.329.0141**
**www.pgwg.com**

# TABLE OF CONTENTS

## TABLES



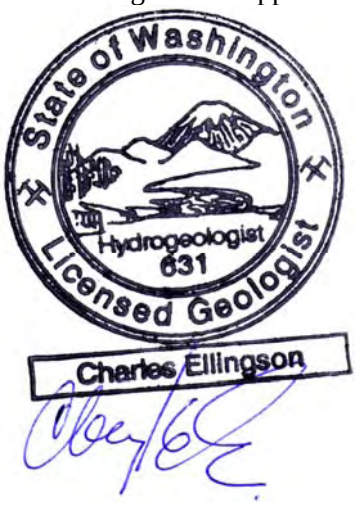
## FIGURES



## APPENDICES

## SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.




**Charles T. Ellingson**
Principal Hydrogeologist
Washington State Hydrogeologist No. 631

# 1.0 INTRODUCTION

Pacific Groundwater Group (PGG) has prepared this Sampling, Analysis and Quality Assurance Project Plan (SAP/QAPP) for Grant County Public Works and the City of Ephrata for investigative work at the Ephrata Landfill ("Landfill" or "Site") (Figure 1). This SAP/QAPP has been prepared in accordance with Chapter 173-340 (820 and 830) Washington Administrative Code (WAC) for cleanup under the Model Toxics Control Act (MTCA), Chapter 70.105D RCW.

The investigative work associated with this SAP/QAPP is scheduled to start during the summer of 2007 and is part of the Remedial Investigation and Feasibility Study (RI/FS) for the Ephrata Landfill. The RI/FS work is being performed to evaluate Landfill cleanup requirements in accordance with WAC 173-340 as described in the RI/FS Work Plan (PGG and Parametrix, 2006). This SAP/QAPP covers investigative work under Task 3 (Exploration for Other Contamination Sources) and Task 4 (Delineation of Groundwater Contamination) described in the RI/FS Work Plan. A separate SAP/QAPP will be prepared for Task 2 (Investigation of Extent of Contamination from Drums) and Task 6 (Pumping Groundwater from the Hole).

# 2.0 PURPOSE AND OBJECTIVES

The purpose of this plan is to present field and analytical procedures which will be used to investigate for sources of contamination at the north end of the Landfill in the vicinity of the shop and to investigate the extent of groundwater contamination down-gradient of the original landfill.

This plan presents field observation and sampling procedures, analytical methods, and data evaluation techniques to be implemented during the investigation.

The plan also identifies data quality objectives for the investigation, and presents the data generation, assessment and validation procedures so that the collected data will achieve its planned quality assurance/quality control (QA/QC) performance criteria.

This SAP/QAPP has been prepared to be consistent with requirements in the Washington Administrative Code WAC 173-340-820 and -830.

# 3.0 PROJECT ORGANIZATION AND MANAGEMENT

The following project organization and management elements describe project roles and responsibilities, documentation, and reporting requirements.

## 3.1 PROJECT ORGANIZATION

The project team is formed by members of Grant County, City of Ephrata and their consultants, Washington State Department of Ecology (Ecology), Pacific Groundwater Group (PGG), and Parametrix, Inc. PGG will subcontract for drilling and laboratory services related to the RI Work.

The project Site is currently owned and operated by Grant County. Derek Pohle is the project manager for Grant County. The County will make arrangements for Site access, provide a County owned and operated backhoe, survey all newly installed monitoring wells, and provide an on-site laboratory trailer for the source area excavation work presented in this plan.

The project Site was formerly owned and operated by the City of Ephrata. Wes Cargo is the City Manager and project manager for the City. The City has retained ENSR (formerly, The RETEC Group, Inc.) to consult regarding environmental cleanup. Halah Voges is the project manager for ENSR.

Ecology is the lead regulatory agency for the project. Cole Carter is Ecology's site manager providing regulatory oversight and approvals.

The primary consultants for the investigative work presented in this plan will be PGG. PGG personnel will be responsible for field activities, data collection, data management, and reporting. The key PGG staff who will be involved in the investigative work are:

- Charles Ellingson, LG, LHG; Project Manager
- Dawn Chapel, LG; Assistant Project Manger, Field Manager, Project QA/QC Manager.
- Jeff Witter; Field and Analysis Support
- Wayne Rennick; GIS Specialist
- Janet Knox, LG, regulatory consultant and senior review

## 3.2 ACCESS CONTROL

The Ephrata Landfill is a fully fenced facility that is locked after hours. Highly controlled access is available to the public during working hours.

Additional access control for RI field activities will be limited to work involving heavy equipment and potential exposure of contaminated soils and waste. For source area investigation work (Task 3), an exclusion zone will be established around each test pit and boring. No access to the exclusion zone will be allowed except for authorized personnel involved with field sampling and who are in compliance with the Health and Safety Plan. The exclusion zone will be marked with cones and barrier tape. It shall surround each test pit and boring while the exploration is open (prior to backfilling). A contaminant reduction zone will be defined that surrounds a group of test pits, borings, and a decontamination station. The contamination reduction zone shall be marked with fence posts, cones, and barrier tape. At least two contaminant reduction zones are envisioned – one north, and one south of the office/shop/scale facility (**Figure 2**).

## 3.3 SPECIAL TRAINING AND CERTIFICATION

All personnel conducting field activities will comply with Washington Industrial Safety and Health Act per Chapter 49.17 RCW.

Borehole drilling and monitoring well installation/construction will be performed by a Washington State licensed well operator.

Laboratory services will be performed by labs accredited by the Washington Sate Department of Ecology.

## 3.4 DOCUMENTATION AND RECORDS

The following data management tools will be used to archive data collected during the remedial investigation:

- Field logs will be photocopied weekly and mailed or faxed to an off-site location.
- A soils and gas database similar to the existing groundwater quality database will be established. Data to be imported into the database will include: coordinates of sample locations; station IDs; and all soil and gas sampling results (both field and laboratory analyses).
- Groundwater quality data will be imported into the existing groundwater database.
- Daily field logs documenting field activities, soil pit and borings, and other key observations will be copied and kept on file.
- Borings, test pits, and monitoring wells will be logged and logs will be archived in a digital format.

- Aquifer pumping test data will be input into an MS Excel spreadsheet and time drawdown plots will be constructed.

Pacific Groundwater Group performs daily backups and monthly archiving of networked hard drive contents. In addition, project directories will be backed-up to compact disks weekly.

## 3.5 REPORTING

Following completion of sampling and analysis under the tasks identified in this SAP/QAPP, PGG will produce a memorandum that summarizes the field data, compares project goals and potential cleanup levels, and identifies data gaps. This RI data memorandum will be submitted to the agencies to facilitate discussion of either performing additional RI field tasks to fill data gaps or proceeding to performance of the FS and production of the RI/FS report. If an additional round of field work is required, PGG will submit an additional SAP/QAPP to define the work. Refer to the Work Plan for description of the RI/FS reporting process.

All data will be submitted to Ecology in both printed and electronic format in accordance with WAC 173-340-840(5). Digital data submittal to Ecology will be through Ecology's Environmental Information Management (EIM) database.

# 4.0 BACKGROUND

This section provides a brief overview of the Site hydrogeology and groundwater quality. A Site map with the location of key features is shown in **Figure 1**.

## 4.1 HYDROGEOLOGY AND GROUNDWATER QUALITY

Two basalt aquifers and an outwash aquifer are currently monitored at the Ephrata Landfill. The Roza and Interflow aquifers occur in permeable weathered zones within the upper parts of the Wanapum Basalt and the Outwash aquifer occurs in the saturated sands and gravel that overlie the basalt. The basalt surface outcrops in the northern part of the Site and is buried by a progressively thicker sequence of outwash sand and gravel towards the east, west and south in the direction of the bedrock slope. The Outwash aquifer is not saturated along most of the northern portion of the Landfill; except for a known low spot in the surface of the basalt below the original landfill known as the "Hole". The groundwater flow direction in all aquifers is generally to the south.

There are currently 23 monitoring wells, 19 of which are sampled routinely as part of environmental compliance monitoring for the Landfill (PGG and Parametrix, 2004). These wells are shown in **Figure 1**. Routine groundwater monitoring indicates that the Roza aquifer and limited areas of groundwater within the Outwash and Interflow aquifers are contaminated with inorganic and organic contaminants. Wells that routinely have detections of organic contaminants exceeding the state Groundwater Contaminant Level (GWCL) or MTCA Method B include: EW-1, EW-2, MW-3b, MW-7b, MW-9b, MW2c, MW-5c, MW-22c, and MW-6a

Potential sources of contamination include: contaminant migration from the unlined original landfill, the buried drums at the northern end of the original landfill and other unidentified sources in the northwest corner of the Site near the current shop (**Figure 1**).

The hydrogeology and current understanding of the extent of contamination at the Ephrata Landfill are discussed in detail in the RI/FS Work Plan (PGG and Parametrix, 2006).

### 4.1.1 Contaminants of Concern

The Site contaminants of concern (COCs) are based on Site history and include:

- Volatile organic compounds
- Semi-volatile organic compounds
- Inorganic compounds and metals

**Table 1** lists the Site COCs and other parameters that will be analyzed as part of this investigation. A constituent is listed as a COC if it continues to exceed either the State Groundwater Contaminant Levels (GWCL) from WAC 173-200 or MTCA Method-B groundwater cleanup levels from WAC 173-340 during routine quarterly monitoring. However, for purposes of providing screening levels for the RI investigative work, only MTCA B levels will be used. Soil MTCA screening levels are based on protection of groundwater (Soil to Groundwater in Table 1) using the fixed parameter three-phase partitioning model (WAC 173-340-747). The soil screening levels were calculated for the protection of groundwater at the Method B level. Where the three phase model could not be used, soil concentrations will be compared to standard MTCA Method B levels (WAC 173-340-740 (3)). Site clean up levels will be formerly defined later as part of the Feasibility Study (FS) based on MTCA requirements.

Other parameters to be analyzed during the groundwater investigation phase include geochemical indicator parameters for general water chemistry characterization, and remedy parameters for evaluating Site remedy options, including water treatment and monitored natural attenuation. These parameters are also listed in **Table 1**.

# 5.0 SOURCE AREA INVESTIGATION

Backhoe test pits and soil borings will be used to sample waste and soil over an approximately triangular area at the northeast end of the Landfill between stations MW-8b (decommissioned), MW-3b, MW-7b and MW-9b (**Figure 2**). This area of the Landfill includes the flat area in the northwestern-most portion, which has been used for equipment storage and repair and other facility maintenance since the Landfill originally began operations in 1942. It also includes portions of the original landfill waste south of the flat area towards the structural low spot in the underlying basalt (the "Hole"). The highest observed concentration of groundwater contamination occurs within the Roza aquifer underlying this area (monitoring wells MW-3b, MW-7b, and MW-9b). These wells are located upgradient of the original landfill waste and cross-gradient from the buried drums, suggesting a separate subsurface source may occur in this area.

## 5.1 SOIL AND WASTE EXCAVATION

Two methods of soil and waste excavation will be used depending on the depth to bedrock. Test pits will first be excavated with a County supplied backhoe in areas where the depth to bedrock is expected to be less than 10-ft. Soil borings will then be advanced with a drill rig in areas where basalt is anticipated to be greater than 10-ft or where basalt was not encountered in the test pits.

Excavation locations will initially be spaced approximately 100-ft apart resulting in 25 to 30 explorations with possible expansion of up to 40. The range in depth to bedrock within the area of investigation is expected to be less than 5-ft near MW-3b and up to 50-ft near the "Hole". We estimate that about 15 of the 40 explorations will be test pits and 25 will be borings. Soil samples will be collected from each major stratum encountered during exploration or at least every 5-ft. This strategy should result in approximately 180 soil samples.

PGG will mark locations of proposed excavations considering previous geophysical survey data, water quality data, groundwater flow directions, access, and underground utilities. Asphalt may be penetrated, but concrete will not be cut. The County will review and approve the locations to verify existing structures will not be damaged. Observations during excavation may result in modifications to the preliminary locations. Details for soil excavation and logging procedures are described below.

### 5.1.1 Test Pit Excavation and Logging Procedures

Test pits will be excavated using a County owned and operated backhoe. Locations furthest from the Landfill access road will be excavated first. Excavations near the access road will be conducted last and will likely occur on Sunday or after hours (after 3pm).

Each test pit will be identified by number (e.g. TP-1, TP-2, etc). The centroid of each test pit will be located both visually on high resolution air photos and with a hand-held GPS receiver. The GPS receiver will be a Delorme Earthmate GPS PN-20 with WAAS location accuracy within 3 meters (10-ft) when WAAS satellites are accessible. Each GPS waypoint will be tied to its unique I.D. number. Pit dimensions ($\Delta x$, $\Delta y$, and $\Delta z$) will be measured with a tape measure and sketched/recorded in field notebooks.

Two PGG personnel will be on site to guide excavation work, log and map soil conditions, collect samples, and conduct field screening analyses. Soil conditions to be logged and mapped will include physical characteristics such as sediment texture, color, staining, odor, and water content. Descriptions of any buried wastes and/or liquids shall also be mapped and recorded. If one side of a pit is noticeably different from another side, this too shall be mapped and recorded. All observed conditions with depth and sampling locations shall be recorded in field notebooks next to the excavation sketches. Digital photos will also be taken of each excavation and tied to its unique I.D number.

Excavated soils and wastes will be stockpiled on plastic liners next to each excavation. Three categories of stockpiles will be maintained:

1. Clean soils: no refuse material and no appearance of contamination.
2. Soils with refuse: soils with actual waste and refuse, but no appearance of contamination.
3. Potentially contaminated soils: soils with appearance of contamination (e.g. sheens, non aqueous phase liquids, drums, plastic pesticide containers, and odors of fuels or solvents).

All stockpiles will be temporarily secured with a plastic cover once excavation is complete pending field screening and disposal. Field screening will be performed on-site by PGG personnel (see Soil Field Screening Procedures below). Category 1 soils with photoionization detector PID readings at or below ambient background conditions will be used to backfill the excavations.

Category 2 soils and Category 1 soils with PID readings above background will be disposed of to the lined landfill cell on-site. Category 3 soils will be drummed on site pending laboratory analytical results with disposal to either the lined landfill on site or an offsite location.

Orange warning tape, signs, and safety cones will be used to delineate opened test pits and provide traffic control. No personnel will enter the test pits at any time. All observations will be made from the surface and all samples will be collected from the back-hoe bucket (see sampling procedures below). All test pits will be backfilled upon completion no later than the following day. Clean granular fill may be used to backfill the test pits in addition to clean excavated soil. At no time will there be more than five test pits left open on-site at one time.

All sampling and logging personnel will wear disposable (latex/nitrile) sampling gloves during excavation work. Fresh gloves should be used for every sample collected.

Temporary soil vapor probe samplers will be installed in each test pit where groundwater is not encountered. Groundwater is not expected to be encountered in the test pits, therefore most test pits will be installed with temporary vapor samplers. Samplers will be installed during backfilling of each test pit and sampled once before decommissioning (see Temporary Soil Vapor Probe Installation below).

### 5.1.2 Soil Borings and Logging Procedures

Excavations greater than 10-ft will be accomplished using a drill rig. All soil borings will be drilled and decommissioned following requirements in WAC 173-160 (400 to 460), General Requirements for Resource Protection Well Construction and Geotechnical Soil Borings. If groundwater is encountered in the soil borings, a monitoring well will be constructed in lieu of decommissioning (see Source Area Monitoring Well Installation below).

Soil borings will be drilled by a Washington certified well driller in accordance with WAC 173-160. A sonic drill rig with continuous coring will likely be used. Two PGG personnel will be on site to guide drilling, log soils, collect samples, and conduct field screening analyses.

Each boring will be identified by number (e.g. B-1, B-2, etc). The location of each soil boring will be located both visually on high resolution air photos and with the hand-held GPS receiver. Each GPS waypoint will be tied to its unique I.D. number.

During drilling, the cores will be stockpiled on plastic liners (or equivalent) and logged by PGG personnel on standard boring log field forms. Soil conditions to be logged will be the same as for the test pits and include physical characteristics such as sediment texture, color, staining, odor, water content, and descriptions of any wastes and/or liquids. Digital photos of any significantly contaminated cores will also be taken and tied to its unique I.D number and its depth of occurrence.

Soil cores that do not appear contaminated will be disposed of to the lined landfill on site. Soil cores that have the appearance of contamination (e.g. sheens, non aqueous phase liquids, and odors of fuels or solvents) will be drummed on site pending laboratory analytical results with disposal to either the lined landfill on site or an offsite location.

Sampling and logging personnel will wear disposable (latex/nitrile) sampling gloves during excavation work. Fresh gloves should be used for every sample collected.

## 5.2 SOIL SAMPLING PROCEDURES

Soil samples will be collected from each major stratum encountered during the excavation of test pits and soil borings, or at least every 5 feet, until bedrock is encountered. This strategy should result in approximately 180 soil samples.

All samples will be field screened on-site for possible analyses by an accredited off-site laboratory. The laboratory will be state certified in accordance with WAC 173-50, Accreditation of Environmental Laboratories. Field screening analyses will include measurement of total volatile organic compounds (VOC) with a photoionization detector (PID) and soil electrical conductivity (EC). A subset of sampled soils will be submitted for laboratory analysis with preference given to soils identified through the field-screening process as likely contaminated.

Ten initial soil samples will be submitted for laboratory analysis with the goal of establishing a correlation between field-screening data and chemical specific laboratory data. The correlation samples will be submitted to the lab early in the investigation with rapid turn around times so that the relationship between field-screening data and chemical specific data can be used to help guide sampling. Five correlation samples will be collected north of the shop, and five will be collected south of the shop.

### 5.2.1 Soil Collection Procedures

Soils sampled from test pits will be collected using the County back-hoe. PGG field personnel will guide the back-hoe operator to the desired soil horizon for collection of samples. Soils sampled from soil borings will be collected by PGG field personnel directly from the soil cores.

In order to preserve sample integrity at a site where dust and wind are likely, a large volume aliquot will be collected using a decontaminated stainless steel hand trowel and placed into a gallon size zip lock bag and transferred to the on-site laboratory trailer for immediate field screening (VOC and EC) and possible sampling for off-site laboratory analysis. Extra care will be taken during collection of the aliquot not to disturb the sample.

Samplers will wear disposable (latex/nitrile) sampling gloves. Each aliquot sample bag will be labeled before transferring to the laboratory trailer as follows:

1. Name of collector
2. Date and time of collection
3. Sample Identification (a unique ID number that ties the sample with the excavation location and depth; e.g. TP-1-5-ft, TP-1-10-ft, B-1-5-ft, B-1-10-ft, etc.). If sampling from a specific side of a test pit, other descriptors such as north, south, east, or west side should also be used in the identification.

Labels will consist of separate tags that are adhered to the zip lock bag. No labeling will be done directly on the zip lock bag.

### 5.2.2 Soil Field Screening Procedures

Field-screening analyses will be performed by PGG personnel in an on-site laboratory trailer. Field-screening activities will be recorded in daily field logs including calibration of PID and EC probes, sample identification numbers, measurement readings, date and time of measurement, and name of personnel performing the measurements.

The PID and EC instruments will be operated and calibrated in accordance with manufacturer's guidelines. The PID instrument will be operated with an 11.7 eV lamp source and calibrated with 10 ppm isobutylene gas. The EC instrument will be capable of measuring conductivity values up to 10,000 umhos/cm.

Ambient vapor conditions on site and in-situ clean soils will be measured with the PID and EC prior to field screening in order to establish background conditions.

Details for field screening procedures follow.

**Total VOC Field Screening**

To conduct total VOC field screening, PGG will:

- Calibrate PID probe in accordance with manufacturer's specifications on a daily basis.
- Prior to making individual PID measurements of the soil samples, PID readings of the ambient air as well as the air in the 8 oz sample jar will be made and recorded.
- Efforts will be made to have both the soil samples and the PID instrument at room temperature.
- A clean, clear, graduated, 8 oz glass jar will be filled with soil from the aliquot up to the 4 oz fill line. Preference will be given to collection of soil matrix (sand sized and smaller) and sampler will wear disposable (latex/nitrile) sampling gloves. A piece of aluminum foil will be placed over the mouth of the jar and will be held in place with a rubber band around the rim of the jar. The jar will then be manually agitated for 30 seconds to allow for release of volatile compounds into the headspace.
- The temperature of the ambient air will be recorded with a digital thermometer. The aluminum foil septum will then be pierced with the digital thermometer and the temperature of the headspace will be measured.
- The thermometer will be removed and the inlet tube of the PID instrument will be inserted into the headspace and a measurement of the maximum VOC concentration in the headspace maintained over 5 seconds will be recorded.

- Care will be taken to make sure the PID inlet tube does not become dirty or wet during the PID measurements to minimize contamination of the PID sensor.
- The soil sample, aluminum foil, and rubber band will be properly disposed of but the 8 oz glass jar will be retained for the EC Field Screening.

**EC Field Screening**

To conduct soil electrical conductivity field screening, PGG will:

- Calibrate EC probe in accordance with manufacturer's specifications on a daily basis.
- The clear, graduated, 8 oz glass jar just used for VOC field screening will be filled with a new sample of soil from the aliquot up to the 4 oz fill line. Preference will again be given to collection of the soil matrix (sand sized and smaller) and samplers will wear disposable (latex/nitrile) sampling gloves.
- The 8 oz sample jar will then be filled to the 8 oz fill line with de-ionized water. The lid of the jar will be secured and the solution shaken until well-mixed. Suspended soil will then be allowed to settle.
- Once the solution has settled, remove lid carefully and insert the EC probe into the clearer fluid at the top of the settled mixture and record reading.

### 5.2.3 Laboratory Sampling Procedures

A subset of sampled soils will be submitted for laboratory analysis with preference given to soils identified through the field-screening process as likely contaminated. Samples submitted for laboratory analysis will be collected from the aliquot as follows:

- Immediately following field screening, collection sample from aliquot and place into laboratory supplied containers. Preference will be given to the soil matrix (sand sized and smaller) and samplers will wear disposable (latex/nitrile) sampling gloves.
- For most soils, U.S. EPA Sample Method 5035A will be used for VOC samples. For soils too coarse in texture for Method 5035A, a decontaminated spatula will be used to collect samples in a laboratory supplied 2 ounce wide mouth jar.
- Record sample identification on all laboratory containers. The sample label on all samples should include at least the following information:
    1. Project name and number
    2. Name of collector
    3. Date and time of collection
    4. Sample Identification (a unique ID number that ties the sample with the excavation location and depth; e.g. TP-1-5-ft, TP-1-10-ft, B-1-5-ft, B-1-10-ft, etc.). If sampling from a specific side of a test pit, other descriptors such as north, south, east, or west side should also be used in the identification.
- Sample containers to be submitted for laboratory analysis will be immediately secured in iced coolers for over night deliveries to the laboratory. Deliveries will occur daily using Federal Express at the Moses Lake Airport. Samples will need to be delivered no later than 4pm for overnight deliveries. Results from correlation samples will be made available within 48 hours (24-hour lab turnaround). The results from these initial samples will provide the correlation between field-screening data and chemical specific data. All subsequent samples submitted will be made available within the normal 2-week turn-around time.

### 5.2.4 Laboratory Parameters and Analytical Methods

The analytical parameters to be tested for by the off-site lab will include all COCs identified in **Table 1**.

Laboratory methods acceptable for analysis of soil samples are to be among those described in EPA publication number SW-846, Test Methods

for Evaluating Solid Waste Physical Chemical Methods; EPA-600/4-91-010, Test Methods for Determination of Metals in Environmental Samples; or EPA-600/4-79-010, Test Methods for Chemical Analysis of Water and Wastes. All laboratory analyses will be completed by Analytical Resource, Inc (ARI) in Tukwila, Washington. ARI is an accredited laboratory in accordance with WAC 173-50. Target practical quantification limits, or reporting limits, for relatively simple matrices will be sufficiently low to allow data to be compared to the MTCA screening levels (WAC 173-340) for COCs as listed in **Table 1**. However, sample reporting limits will vary between samples due to sampling matrices and individual laboratory batches.

A minimum of 36 waste/soil samples will be submitted for laboratory analysis.

### 5.2.5 Chain-of-Custody Forms

Laboratory chain-of-custody form(s) must be completed for each set of samples sent to the lab and placed in the shipping cooler for travel with the sample shipment. These forms are provided by the analytical laboratory as a record for tracking samples from the point of collection to the laboratory. A copy of a chain-of-custody is provided in **Appendix A**. Upon transfer of sample possession to subsequent custodians, this form will be signed by the person taking custody of the sample container. As part of the chain-of-custody procedure, each sample container being delivered will be tracked by the Site name, sample number, analytical testing to be performed, and other pertinent information.

### 5.2.6 Equipment Decontamination and Disposal of Excavated Materials

Sampling equipment (spatula and glass wear) will be decontaminated between sampling with a three-step wash. The wash should consist of:

- Decontamination detergent (such as Alconox) and water wash
- Tap water rinse
- De-ionized water rinse

Disposable gloves (latex/nitrile) will also be discarded after each use.

A decontamination station will be used to power wash the backhoe bucket before each test pit is excavated. The decon-station will consist of a plastic liner pad to collect all wash water. Wash water will be allowed to evaporate and upon completion of the investigation the plastic liner will be disposed of to the lined landfill cell on site.

Soils excavated from test pits that contain refuse or have PID readings above background will be disposed to the lined landfill cell on site (clean soils will be used to backfill test pits). Soil cores from borings that do not appear contaminated will also be disposed of to the lined landfill on site.

Excavated soils from borings or test pits that have the appearance of contamination (e.g. sheens, non aqueous phase liquids, and odors of fuels or solvents) will be drummed on site pending laboratory analytical results with disposal to either the lined landfill on site or an offsite location.

All test pits will be installed with temporary vapor sampling probes during backfilling. Installation of vapor sampling probes and vapor sampling procedures are described below.

Soil borings will be decommissioned in accordance with WAC 173-160 (400 to 460), General Requirements for Resource Protection Well Construction and Geotechnical Soil Borings. Groundwater is not anticipated in the borings; however, if groundwater is encountered in any soil borings, a monitoring well will be constructed in lieu of decommissioning. No permanent wells will be allowed within the new Landfill access road alignment that will traverse this area. Source area monitoring well installation is described below.

## 5.3 SOURCE AREA TEMPORARY SOIL VAPOR PROBE INSTALLATION

Temporary soil vapor samplers will be installed in all excavated test pits that do not encounter groundwater. Groundwater is not expected to be encountered in the test pits, therefore most test pits will be installed with temporary vapor samplers. Samplers will be installed during backfilling of each test pit and sampled once before decommissioning. Soil vapor probes (VP) will be assigned identification numbers that correlate to the excavation pit I.D. (e.g. VP-TP-1).

Temporary samplers will be constructed using 3/4-inch diameter PVC screen and riser pipe. A maximum 1-ft long 0.20-slot screen will be used. All fittings will be threaded with no use of adhesives. The screen will be installed at the bottom of all test pits with a minimum depth of 3-ft below ground surface. The riser pipe will extend approximately 2 feet above ground surface and a 1/4-inch diameter gas probe valve will be fastened to the top of the riser pipe.

Upon completion of soil vapor sampling (see next section) temporary vapor probes will be decommissioned by filling the probes with bentonite slurry and cutting PVC riser stickup to 0.5 to 1-ft below ground surface.

## 5.4 SOIL VAPOR AND LANDFILL GAS SAMPLING PROCEDURES

All temporary soil vapor samplers installed in the test pits, and all existing landfill gas extraction wells (GE-1 through GE-50 in Figure 1) will be field screened for possible laboratory analysis of COC organic parameters in **Table 1**.

Soil vapor and landfill gas samples will be field-screened for total volatile organic compounds (VOC) with a photoionization detector (PID). The PID will be operated and calibrated in accordance with manufacturer's guidelines. The PID instrument will be operated with an 11.7 eV lamp source and calibrated with 10 ppm isobutylene gas. A response factor will be used to yield output of "total organic vapors" in parts per million as benzene. The following procedures will be used for field screening:

- Calibrate PID probe in accordance with manufacturer's specifications.
- Collect and record ambient vapor conditions on site.
- Attach air pump to probe valves and purge probes until readings are consistent for 30 seconds.
- Record steady-state PID reading on field form.

For all field-screening samples where PID readings are greater than ambient site conditions, PGG will collect sample for laboratory analysis using the following procedures:

- Pump vapor/gas sample directly into 1-liter laboratory supplied Tedlar® bags or SUMMA® canister.
- If Tedlar ® bags are used; collect two samples from each probe (the extra sample will serve as backup in case one bag leaks during shipment to lab).
- Record sample identification on all containers. The sample label should include at least the following information:
    1. Project name and number
    2. Name of collector
    3. Date and time of collection
    4. Sample Identification
- For quality assurance and control purposes, collect a duplicate sample for every 20 samples (with preference given to probes with high PID readings). Collect duplicate sample in separate container. This sample should be labeled with a fictitious name but the probe from which it was collected will be noted in the field logs. The duplicate sample should be collected immediately after the original sample.

- Between sampling stations decontaminate sampling equipment with ambient air for 2 minutes to purge residual gas.
- Place all samples to be submitted for laboratory analysis into secured coolers for overnight delivery to the laboratory.

Deliveries will be made via Federal Express at the Moses Lake Airport. Samples will need to be delivered no later than 4pm for overnight deliveries. Laboratory gas analyses will be completed by Test America in Bothel, Washington. Test America is a state accredited laboratory in accordance with WAC 173-50.

A chain-of-custody form(s) will be completed for each set of samples sent to the lab and placed in the shipping cooler for travel with the sample shipment.

## 5.5 SOURCE AREA MONITORING WELL INSTALLATION

If groundwater is encountered during drilling of soil borings, a monitoring well will be constructed in lieu of decommissioning the borehole. All monitoring wells will be constructed in accordance with WAC 173-160, the Minimum Standards for Construction and Maintenance of Wells.

Wells will be constructed with 2-inch diameter, Schedule 40 PVC casing and screen with flush threaded joints and O-rings seals. Screen lengths will be 5 feet and sand packed with Colorado Silica Sand. Well seal material above the screen will consist of bentonite chips. The well casing will extend approximately 2 feet above ground surface and be protected with an 8-inch locking steel monument. Three bollards will be cemented in around each well to provide protection.

All monitoring wells will be surveyed for location and elevation in the state plane coordinate system by the County within 0.01 foot accuracy. Newly installed wells will be developed to remove suspended fines and to ensure hydraulic connection with the aquifer. Development waste water will be drummed in 55-gal drums and disposed by the County including possible evaporation.

Groundwater samples will be collected from all newly installed source area monitoring wells as part of the groundwater sampling plan described below.

# 6.0 GROUNDWATER CONTAMINATION INVESTIGATION

The plume of groundwater contamination at the site is concentrated within the Roza aquifer in the northwest corner of the Landfill but is slowly expanding to the south with possible smaller components of flow to the east and west within the Interflow and Outwash aquifers. The Roza aquifer does not extend off-site in downgradient directions; the aquifer either pinches-out or truncates against subsurface troughs eroded into the basalt surface. Mobile and persistent contaminants in the Roza aquifer may either migrate vertically downward to the Interflow aquifer or laterally to the Outwash aquifer where the Roza truncates. Downward migration to deeper basalt aquifers is also possible; however, as described in the RI/FS Work Plan, deeper migration below the Interflow Aquifer is expected to be minor.

Five new monitoring wells will be installed at strategic locations to delineate the extent of plume migration. Each well is located to better delineate the groundwater plume. The location of these additional wells is summarized below and shown in **Figure 1:**

- One Interflow aquifer well southeast of MW-2c on County property (approximately 60-ft deep).
- Two Interflow aquifer wells near MW-11a (approximately 60-ft deep) and MW-10a on County property if possible (approximately 85-ft deep).
- One Frenchman Springs aquifer well near MW-5c (approximately 375-ft deep).

- One Roza aquifer well southwest of MW-9b on County property (approximately 70-ft deep).

See the RI/FS Work Plan (PGG and PMX, 2006) for a more detailed discussion of the Site hydrogeology and groundwater quality.

Additional angled monitoring wells are also proposed to investigate groundwater beneath the buried drums at the north end of the Landfill. A separate SAP/QAPP will be prepared for this investigation once the drum removal and soil exploration work has been completed (Parametrix, 2007 and PGG, 2007).

Borehole geophysical logging will be conducted in selected new monitoring wells and existing basalt monitoring wells. The geophysical logs will be used to map and correlate the lateral continuity of distinct lithologic zones within the basalt bedrock. The logs will include magnetic field, natural gamma, and conductivity logs.

The following sections describe procedures for drilling and installation of the new monitoring wells, groundwater sampling, and geophysical logging.

## 6.1 MONITORING WELL DRILLING AND INSTALLATION

All monitoring wells will be constructed and designed in accordance with WAC 173-160, the Minimum Standards for Construction and Maintenance of Wells.

All vertical wells will be drilled with an air rotary drill rig. Wells will be constructed with 2-inch diameter, Schedule 40 PVC casing and screen with flush threaded joints and O-rings seals. Screen lengths will be 5 or 10 feet long and sand packed with Colorado Silica Sand. Well seal material above the screen will consist of bentonite chips. The well casing will extend approximately 2 feet above ground surface and be protected with an 8-inch locking steel monument. Three bollards will be cemented in around each well to provide protection.

A PGG geologist will be onsite during drilling and construction to document the work and log borings. PGG will use prior site borings and field data to identify the target completion zones identified above. All monitoring wells will be surveyed for location and elevation in the state plane coordinate system by the County within 0.01 foot accuracy. Newly installed wells will be developed to remove suspended fines and to ensure hydraulic connection with the aquifer. Development waste water will be drummed in 55-gal drums and disposed by the County including possible evaporation.

Wells will be equipped with a dedicated Grundfos™ Redi-flo2 pump and discharge tubing. Brief aquifer pumping tests will also be conducted (see Short-Term Aquifer Pump Test below).

### 6.1.1 Drilling Equipment Decontamination and Waste Disposal

Drilling equipment will be steam cleaned between holes. Decon water and water pumped from completed wells will be drummed and left on site for County disposal including evaporation. Drill cuttings will be disposed to the ground near the wells.

### 6.1.2 Frenchman's Springs Monitoring Well

During drilling of the deeper Frenchman Springs well, the water bearing zones above the Frenchman Springs aquifer will be sealed in accordance with WAC 173-160-181 before advancing into the Frenchman Springs aquifer. Groundwater will be sampled at each major aquifer within the Frenchman Springs aquifer during drilling to a depth of about 375 feet. In order to collect groundwater samples from the desired interval during drilling, samples will be collected using a double pump method. An upper pump will operate at the top of the water column in order to generate an upward flow within the well and a lower sampling pump will be set at the desired interval at the bottom of the boring.

Samples will be analyzed by a state accredited laboratory with rapid turnaround for COC organic parameters (**Table 1**). Results of water quality analyses, groundwater head, and boring log will be used to design a single completion monitoring well in the Frenchman Springs aquifer or other zone mutually agreed-to by the project team.

### 6.1.3 Short-Term Aquifer Pump Tests

Brief aquifer pumping tests will be conducted at all newly installed wells to assess aquifer properties and appropriate sampling flow rate. Tests will be performed using the dedicated Grundfos™ pump systems. Landfill personnel will supply a generator to power the pump. The aquifer tests will be performed before water quality samples are collected, with the pumping test serving as the purging of the well (see groundwater sampling procedure below). Water-level measurements will be taken as often as possible during the pump test/purging to the nearest 0.01-foot using Grant County's water level probe.

A short step-rate pumping test will be used to narrow-in on a sustainable pumping rate for a constant rate test. A constant rate test not exceeding one hour duration will be performed on each new well. Flow rates will be measured by routing discharge through a flow meter. Field water quality parameters will be measured periodically during the test. After the test, the pumping rate will be reduced to less than 1 gallon per minute (gpm) for sampling.

Total volume of water removed from the well will be recorded, and depth to water will be measured after sampling to qualitatively ascertain well recovery. All purge water will be drummed on site and disposed by County including possible evaporation.

## 6.2 GROUNDWATER SAMPLING

Groundwater samples will be collected from all new and existing wells and analyzed for all COCs, geochemical indicators, and natural attenuation parameters listed in **Table 1**. Up to three more groundwater sampling events (quarterly) from new and existing wells will be performed for all COCs listed in **Table 1**.

All wells except for the possible shallow wells in the source area will be fitted with dedicated Grundfos™ Redi-flo2 sampling pumps capable of flow from near zero to 3 gpm. The pumps will be located within the screened section of the well. Water will be purged at a minimum pumping rate of 0.5 gpm but no more than 1 gpm. For the new wells, sampling will occur towards the end of the short-term pump test (see above).

Wells will be purged until select field parameters reach stabilization (see following section). Field meters and field testing kits shall be calibrated and used in accordance with manufacturer guidelines. Purge volume shall be measured with a graduated 5-gallon bucket. All field measurements will be recorded on field sampling forms (**Appendix A)**.

The following section describes the sampling procedures in more detail.

### 6.2.1 Sampling Collection Procedure

The following steps will be followed for collection of groundwater samples:

1. Calculate and record casing storage volume as a reference.
2. Begin pumping the well and quickly adjust the flow rate to the target value of 0.5 to 1 gpm.
3. During purging, measure and record the following field parameters every few minutes:
    - Depth to Water
    - pH
    - Electrical Conductivity
    - Temperature
    - Dissolved Oxygen

- Redox Potential
- Purge water cumulative volume

Redox, DO, pH, and EC will be measured in a flow through cell with a multi probe meter such as YSI®556 Multi-Probe System.

4. Sampling may begin when the field parameters are reasonably stable between two consecutive measurements as indicated below:
   - pH measurements that do not vary by more than 0.1 pH units between readings.
   - Electrical Conductivity, Temperature, Dissolved Oxygen, and Redox Potential do not indicate a trend (continuously increase or decrease between readings) and do not vary by more than 10 percent between readings.
5. If the field water quality parameters listed above continually change in an upward or downward trend, purge until reasonable stability is achieved, then sample. If they change in an inconsistent way and no long term trends exist, sampling may begin. Even at 0.5 gallons per minute, some wells may not achieve stable water levels because of low yield. In that case, field personnel may choose to reduce the flow rate to a sustainable rate and follow these procedures, or evacuate the well and sample as soon as the water level has recovered sufficiently.
6. Collect samples of water for analysis of COCs, geochemical indicator parameters, and natural attenuation parameters listed in **Table 1** for the first sampling round. For all subsequent sampling rounds collect samples for analysis of COCs only. Collect samples in a manner that minimizes contact of the samples with air. Collect samples in the following order: volatile organic compounds, other organics, and then inorganic constituents. Hands and clothing shall be clean when sampling. Clean, disposable, latex gloves shall be worn when filling bottles for trace organic analyses. Follow individual sample container requirements for sample collection, handling, preservation, and shipment. Sample containers for volatile organic analyses should contain no bubbles (head space) after filling.
7. Samples for dissolved metals analysis will be filtered in the field using a 0.45 micron in-line filter. The filtration shall be recorded on the form of **Appendix A**, the metals bottle, and the chain of custody form.
8. Record sample identification data on container, on the sampling field data sheet, and on the sample chain of custody record. The sample label shall include at least the following information:
   - Project name and number
   - Name of collector
   - Date and time of collection
   - Place of collection
   - The sample designation which shall be the well number
   - Presence of any preservative or filtration
   - Place samples in a cooler at approximately 4 degrees C with sufficient chemical ice to retain a cold temperature for 24 hours.
9. Samples will be shipped to the laboratory in a sealed cooler accompanied by Chain-of-Custody forms and any other pertinent shipping/sampling documentation. One Chain-of-Custody form will be used per laboratory shipment.

### 6.2.2 Parameters and Analytical Methods

The analytical parameters to be tested by the lab will include COCs, geochemical indicator parameters and natural attenuation parameters for the first sampling event (**Table 1**). Up to three more sampling events (quarterly) will also occur for COCs.

Laboratory methods acceptable for analysis of groundwater samples are to be among those described in EPA publication number SW-846, Test Methods for Evaluating Solid Waste Physical Chemical Methods; EPA-600/4-91-010, Test Methods for Determination of Metals in Environmental Samples; or EPA-600/4-79-010, Test Methods for Chemical Analysis of Water and Wastes. All laboratory analyses will be completed by Analytical Resource, Inc (ARI) in Tukwila, Washington. ARI is an accredited laboratory in accordance with WAC 173-50. Target practical quantification limits, or reporting limits, for relatively simple groundwater matrices will be sufficiently low to allow Site data to be compared to the MTCA groundwater cleanup levels (WAC 173-340) for COCs as listed in **Table 1**. However, PQLs will vary between samples and analytical methods, therefore no guarantee can be made that all PQLs will be below all cleanup levels.

## 6.3 BOREHOLE GEOPHYSICAL LOGGING

The newly installed Frenchmans Springs aquifer well and selected other existing wells will be geophysically logged using magnetic field, natural gamma, and conductivity logs to assist in geologic correlation across the monitoring network.

Magnetic logging will assist in the identification of the major divisions between basaltic lava units based on their magnetic polarity: Roza Member (transitional-to-reverse polarity) and Frenchman Springs Member (normal polarity).

Natural gamma logging enables the differentiation between basalts and clay-rich interbedded sediments due to the difference in natural radioactivity emanating from these two sources.

Conductivity logging will also aid in the identification of rock vs. sediment due to differences in the conductivity of the medium.

# 7.0 QUALITY ASSURANCE AND QUALITY CONTROL

The following sections describe the quality assurance/quality control (QA/QC) measures to be preformed during the investigative work.

## 7.1 FIELD QUALITY CONTROL

Field QA/QC samples (soils and groundwater) will consist of field duplicates, field matrix spike/matrix spike duplicates, and trip blanks. The QA/QC field sampling methods are described below.

- For soils sampled as part of the source area investigative work, two sets of field quintuplicates (5) will be collected following the procedure for soil sampling described above. Field quintuplicate samples will be collected from two locations (test pits or soil borings) where contaminants are expected to be detected. For both locations a total of six samples will be collected; one for the original analysis and five for the duplicate analysis. The duplicate analyses will be assessed for small scale variability in soil samples.
- For groundwater sampled as part of the groundwater contamination investigative work, one duplicate will be collected during each sampling round following the procedures for groundwater sampling described above. Field duplicate samples will be collected from wells where contaminants are expected to be detected.
- A field matrix spike and matrix spike duplicate will be collected for every 20 samples (soil and groundwater) collected for labora-

tory analysis. Three sets of samples will be collected from a given location, one labeled with the identification for the original analysis, one labeled with the identification and suffix "-MS" and the final labeled with the identification and suffix "-MSD". The laboratory will analyze the three samples and will perform matrix spike and matrix spike duplicate analyses on the two extra sets of samples.

- A laboratory trip blank will be provided by the laboratory in order to assess cross contamination of one in every 20 samples during transport. The laboratory will prepare 40-ml VOC containers with laboratory supplied soil or water for transport with the clean bottles from the lab to the field and back to the lab. The analytical laboratory will analyze the trip blank for the presence of volatile organic compounds.

Target acceptance criteria will be in accordance with the Contract Laboratory Program (CLP) National Functional Guidelines or analytical lab guidelines.

## 7.2 LABORATORY QUALITY CONTROL

Analytical Resources, Inc. (ARI) will perform the soil and water analyses for the investigation. ARI is accredited in accordance with WAC 173-50. ARI will follow their standard QA protocol during analysis of soil samples. **Appendix B** contains ARI Quality Assurance Manual which contains the following information:

- Summary of lab requirements for field sample containers, preservatives, and holding times.
- Quality control and calibration procedures; and
- Data management

ARI may subcontract to other accredited labs.

## 7.3 QUALITY ASSURANCE OBJECTIVES

Quality assurance objectives for analytical data are usually expressed in terms of bias and precision. The investigation data will be evaluated using the parameters discussed below.

**Bias**. A matrix spike is prepared by adding a known amount of a pure compound to the environmental sample. A blank spike is prepared by adding a known amount of a pure compound to a laboratory-prepared blank sample. The spikes check for analytical interferences. The calculated percent recovery of the spike is taken as a measure of the bias of the total analytical method. When there is no change in volume due to the spike, percent recovery is calculated as follows:

$$PR = \frac{(O - X) \times 100}{T}$$

Where:

PR = percent recovery

O = measured value of analyte concentration after addition of spike

X = measured value of analyte concentration in the sample before the spike is added

T = value of the spike

Tolerance limits for the acceptable percent recovery of matrix spikes and blank spikes are established by the lab in accordance with CLP Guidelines.

**Precision**. Laboratory replicates are used to indicate precision. Laboratory replicates are aliquots made in the laboratory of the same sample and each aliquot is treated the same throughout the analytical method. The percent difference between the values of the replicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$RPD = \frac{2 \times (D_1 - D_2) \times 100}{(D_1 + D_2)}$$

Where:

RPD = relative percent difference

$D_1$ = first aliquot value

$D_2$ = second aliquot (replicate) value

If the precision values for the laboratory replicate are outside the laboratory tolerance limit, the laboratory should recheck the calculations and/or identify the problem. Reanalysis may be required. If the precision values for either the laboratory replicate or field duplicate are outside the tolerance limit, sample results associated with the out-of-control precision results may be qualified at the time of validation.

## 7.4 LABORATORY DATA REVIEW

Analytical data will be evaluated by PGG's project QA/QC manager with respect to the requirements of the project as specified herein. The manager will evaluate the data following Level III data-validation guidelines. These guidelines require the lab to report method blank, matrix spike and lab replicate results, but not raw data or instrument-calibration information. These guidelines are found in the CLP Guidelines.

## 7.5 FIELD INSTRUMENT QUALITY CONTROL

All field instruments will be operated and calibrated in accordance with manufacturer guidelines and documented in daily field logs. During the source area soil investigation, gas meter readings of ambient vapor conditions on site and in-situ clean soil gas will be measured prior to field-screening in order to establish background conditions on site.

# 8.0 REFERENCES


Pacific Groundwater Group and Parametrix. 2004. *Environmental Monitoring Plan Original and New Ephrata Landfills.* Consultant's report prepared for Grant County Public Works and City of Ephrata.

Pacific Groundwater Group and Parametrix. 2006. *Final Remedial Investigation/Feasibility Study (RI/FS) Work Plan Ephrata Landfill Corrective Action.* Consultant's report prepared for Grant County Public Works and City of Ephrata.

Pacific Groundwater Group. 2007. *Sampling Analysis and Quality Assurance Project Plan Remedial Investigation (Task 2a) Soil Contamination Investigation beneath Drums Ephrata Landfill Corrective Action.* Consultant's report in preparation for Grant County Public Works and City of Ephrata.

Parametrix. 2007. *Drum Waste Handling, Sampling and Analysis Plan.* Consultant's report in preparation for Grant County Public Works and City of Ephrata.

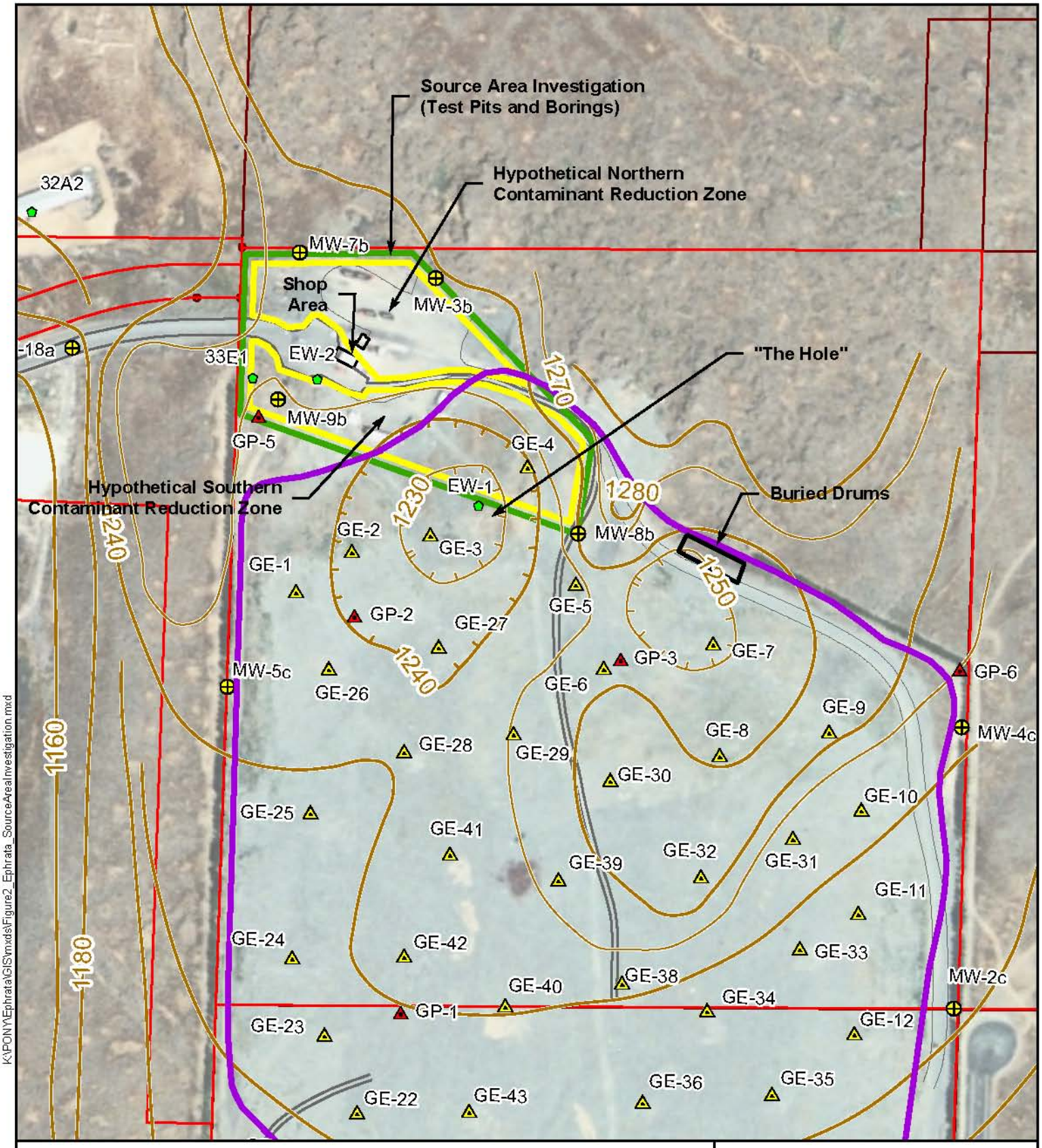
**Table 1. Contaminants of Concern and Other Analytical Parameters**

| Contaminants of Concern (Water, Soil and Gas[1]) | | | | | | |
|---|---|---|---|---|---|---|
| | | MTCA-B Levels | | | ARI Reporting Limits | |
| **Organic Parameters** | **Analysis Method** | **Water (ug/L)** | **Soil (mg/Kg)** | **Soil to Groundwater (mg/Kg)** | **Water (ug/L)** | **Soil (mg/Kg)** |
| 1,2-Dichloroethane (EDC) | 8260B | 0.48 | 11 | 0.002 | 0.2 | 0.001 |
| 1,1-Dichloroethane | 8260B | 800 | 8000 | 4.367 | 0.2 | 0.001 |
| Chloroethane | 8260B | 15 | 350 | NA | 0.2 | 0.001 |
| Tetrachloroethene (PCE) | 8260B | 0.081 | 1.9 | 0.001 | 0.2 | 0.001 |
| Trichloroethene (TCE) | 8260B | 0.11 | 2.5 | 0.001 | 0.2 | 0.001 |
| 1,1-Dichloroethene | 8260B-SIM | 0.073 | 1.7 | 0.001 | 0.02 | 0.001 |
| cis-1,2-Dichloroethene | 8260B | 80 | 800 | 0.401 | 0.2 | 0.001 |
| trans-1,2-Dichloroethene | 8260B | 160 | 1600 | 0.870 | 0.2 | 0.001 |
| Vinyl Chloride | 8260B-SIM | 0.029 | 0.67 | 0.0002 | 0.02 | 0.0002 |
| Chloromethane | 8260B | 3.4 | 77 | NA | 0.2 | 0.001 |
| Dichloromethane (Methylene Chloride) | 8260B | 5.8 | 130 | 0.025 | 0.2 | 0.001 |
| Trichlorofluoromethane | 8260B | 2400 | 24000 | NA | 0.2 | 0.001 |
| 1,2-Dichloropropane | 8260B | 0.64 | 15 | 0.003 | 0.2 | 0.001 |
| Benzene | 8260B | 0.8 | 18 | 0.005 | 0.2 | 0.001 |
| Toluene | 8260B | 640 | 6400 | 4.652 | 0.2 | 0.001 |
| Ethylbenzene | 8260B | 800 | 8000 | 6.844 | 0.2 | 0.001 |
| Xylene (m, p, o) | 8260B | 1600 | 16000 | 14.537 | 0.2 | 0.001 |
| 1,2-Dichlorobenzene | 8260B | 720 | 7200 | 8.449 | 0.2 | 0.001 |
| 1,4-Dichlorobenzene | 8260B | 1.8 | 42 | 0.030 | 0.2 | 0.001 |
| Bis(2-ethylhexyl) Phthalate | 8270B | 6.3 | NA | NA | 1 | NA |
| **Inorganic Parameters** | **Analysis Method** | **Water (ug/L)** | **Soil (mg/Kg)** | **Soil to GW (mg/Kg)** | **Water (ug/L)** | **Soil (mg/Kg)** |
| Chloride | 325.2 | NA | NA | NA | 1000 | 10 |
| Sulfate | 375.2 | NA | NA | NA | 2000 | 20 |
| Total Dissolved Solids (TDS) | 160.1 | NA | NA | NA | 10000 | - |
| Nitrate | 353.2 | NA | 8000.00 | NA | 10 | 0.1 |
| **Metals** | **Analysis Method** | **Water (ug/L)** | **Soil (mg/Kg)** | **Soil to GW (mg/Kg)** | **Water (ug/L)** | **Soil (mg/Kg)** |
| Arsenic, Dissolved | 200.8 | 0.058 | 0.67 | NA | 0.04 | 0.2 |
| Iron, Total | 6010B | NA | NA | NA | 50 | 5 |
| Manganese, Total | 6010B | 2200.00 | 11000.00 | NA | 50 | 0.1 |
| 1 Gas samples will only be analyzed for VOCs, Soil and Air will not be sampled for SVOCs | | | | | | |

| Geochemcial Indicators (Water Only) | Analysis Method |
|---|---|
| Alkalinity (CaCO3) | 2320B |
| Total Dissolved Solids | 160.1 |
| Chloride | 325.2 |
| Magnesium | 6010B |
| Sulfate | 375.2 |
| Calcium | 6010B |
| Potasium | 6010B |
| Sodium | 6010B |
| Total Organic Carbon | 415.1 |

| Monitored Natural Attenuation (Water Only) | Analysis Method |
|---|---|
| Ethane/ethene | RSK 175 |
| Nitrate/Nitrite/TKN | 353.2/351.2 |
| Dissolved Methane | RSK 175 |
| Dissolvd $CO_2$ | RSK SOP 175 |

| Field Parameters | Water | Soil | Vapor |
|---|---|---|---|
| Odor (qualitative) | X | X | |
| Dissolved Oxygen | X | | |
| Redox Potential | X | | |
| Temperature | X | | |
| Electrical Conductivity | X | X | |
| pH | X | | |
| Total Volatile Organic Compounds (PID) | | X | X |


Source Area Investigation
(Test Pits and Borings)
Hypothetical Northern
Contaminant Reduction Zone
Shop
Area
"The Hole"
Hypothetical Southern
Contaminant Reduction Zone
Buried Drums
32A2
-18a
33E1
MW-7b
MW-3b
EW-2
MW-9b
GP-5
EW-1
MW-8b
GE-1
GE-2
GE-3
GE-4
GE-5
GE-6
GE-7
GE-8
GE-9
GE-10
GE-11
GE-12
GE-22
GE-23
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GE-36
GE-38
GE-39
GE-40
GE-41
GE-42
GE-43
GP-1
GP-2
GP-3
GP-6
MW-2c
MW-4c
MW-5c
1160
1180
1240
1230
1270
1280
1250
K:\PONY\Ephrata\GIS\mxds\Figure2_Ephrata_SourceAreaInvestigation.mxd
Well Type
Monitoring Well (MW)
Gas Extraction (GE)
Gas Probe (GP)
Other Well
County Owned Parcels
Landfill Extents
Basalt Elevation Contours
(December 2005)
10-foot Contour
5-foot Contour
10-foot Depression Contour
5-foot Depression Contour
0 Feet 250
N
2006 NAIP Orthophoto
Figure 2
Source Area Investigation
RI SAP/QAP
Ephrata Landfill
Remedial Investigation
PgG


Figure 1
Project Site

RI SAP/QAP
Ephrata Landfill
Remedial Investigation

PgG

# APPENDIX A
# CHAIN OF CUSTODY AND SAMPLING FORMS

# GROUNDWATER SAMPLING FIELD DATA SHEET

Well #: _____

Sample #: _____

Project Number: _____ Date: _____
Project Name: _____ Location: _____
Project Address: _____ Sampled By: _____
Client Name: _____ Purged By: _____

Casing Diameter: 2"_____ 4"_____ 6"_____ Other _____

Depth to Water (feet): _____ Purge Volume Measurement Method: _____
Depth of Well (feet): _____ Date Purged: _____
Reference Point (surveyors notch, etc.): _____ Purge Time (from/to): _____
Day/Time Sampled: _____ Water Level Probe Used: _____

Purge Volume Calculation: $(\pi r^2 h)(7.48\ gal/ft^3)$(3 casing volumes)
Purge Volume (gallons) for 2" = (0.49)(h); 4" = (1.96) (h); 6" = (4.41) (h)
Calculated Purge Volume (gallons): _____ Actual Purge Volume (gallons): _____

| TIME (2400 hr) | CUMULATIVE VOLUME (gal) | pH (units) | EC (umhos/cm 25 c) | COLOR (visual) | TURBIDITY (visual) | ODOR | OTHER |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |

Purging Equipment: _____ Sampling Equipment: _____

Laboratory: _____ Date Sent to Lab: _____
Chain-of-Custody (yes/no): _____ Field CC Sample Number: _____
Shipment Method: _____ Split with (names/organizations): _____

Well Integrity: _____

| Quantity: | Container: | Preservatives: | Filtered (type): | Remarks: |
|---|---|---|---|---|
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| | | | | |

Signature: _____

Page _____ of _____

Pacific Groundwater Group

# Chain of Custody Record & Laboratory Analysis Request

| | | | |
|---|---|---|---|
| ARI Assigned Number: | Turn-around Requested: | Date: | |
| ARI Client Company: | Phone: | Page: | of |
| Client Contact: | | No. of Coolers: | Cooler Temps: |
| Client Project Name: | | | |
| Client Project #: | Samplers: | | |

**Analytical Resources, Incorporated**
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

| Sample ID | Date | Time | Matrix | No. Containers | Analysis Requested | | | | | | | | Notes/Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | |

| Comments/Special Instructions | Relinqushed by: (Signature) | Received by: (Signature) | Relinquished by: (Signature) | Received by: (Signature) |
|---|---|---|---|---|
| | Printed Name: | Printed Name: | Printed Name: | Printed Name: |
| | Company: | Company: | Company: | Company: |
| | Date & Time: | Date & Time: | Date & Time: | Date & Time: |

***Limits of Liability:*** *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

**Sample Retention Policy:** Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer. Sediment samples submitted under PSDDA/PSEP/SMS protocol will be stored frozen for up to one year and then discarded.

# APPENDIX B
# ANALYTICAL RESOURCES INC. QUALITY ASSURANCE MANUAL

# Analytical Resources Inc. Quality Assurance Plan

# Quality Assurance Plan

## Analytical Resources, Inc.
## 4611 S. 134th Place, Suite 100
## Tukwila, WA 98168-3240

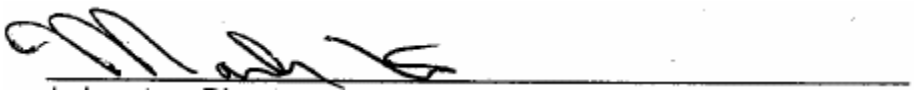
## Revision 12-007
## 4/11/06

**Uncontrolled Copy**

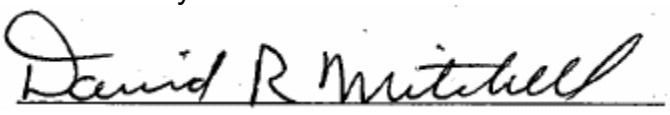
A web page is configured to inform you if this is the most recent version of ARI's LQAP. Click on the link or type the URL into your web browser. No web access? Phone 206-695-6200

http://arilabs.com/cgi-bin/rcheck.cgi?f=LQAP&r=R12007

This Quality Assurance Plan is approved and authorized for release by:



Mark Weidner
Laboratory Director



David Mitchell
Quality Assurance Manager

# Quality Assurance Plan

# Analytical Resources Inc.

**Table of Contents:**

# SECTION 1: INTRODUCTION

## Quality Assurance Policy and Objectives

Analytical Resources, Inc. (ARI) is dedicated to providing accurate and reliable data in a timely and cost effective manner. The management of ARI is committed to analytical excellence and will provide the facilities and a professional environment to achieve this goal. The quality assurance program detailed in this document sets forth the policies and procedures that are followed by ARI to ensure that all reported results are both legally defensible and of the highest quality.

To ensure that data quality goals are achieved, the following characteristics must be considered:

### Precision, Bias and Accuracy

For all analyses, there is a degree of uncertainty or error in the measurement process. This measurement error is generally one of two types: random error (precision) or systematic error (bias). Precision is a measure of agreement between replicate measurements. Bias is considered to be the difference between the expected value and the true value for a measurement or series of measurements. Accuracy is a determination of how closely a measurement is to the expected value. Both precision and bias are considered when determining the accuracy of measurements. Precision, bias and accuracy are evaluated through the use of method guidelines, and project and laboratory control limits.

### Representativeness

Representativeness is an indicator of how closely one sample aliquot resembles another aliquot from the same bulk source or sample site. Sample representativeness is more easily obtained for particulate-free water samples than for solid samples or viscous liquids. Representativeness is an important consideration in achieving other data quality objectives.

### Completeness

Completeness is an indicator of the number of valid (useable) data points compared with the overall number of data points obtained. Valid data are normally obtained when sample collection and analysis is performed in accordance with specified methods and procedures. Completeness is often expressed as a percentage: the higher the number of valid data points, the higher the overall completeness percentage. Conversely, fewer valid data points will result in an overall lower percentage of completeness. Project specifications will dictate the required level of completeness.

**Comparability**

Comparability is an indicator of how confidently one data set can be compared with another, as well as the consistency between data sets. Stable analytical conditions and adherence to standard procedures, combined with high levels of accuracy; help ensure that results obtained over a period of time will be comparable.

**Timeliness**

To ensure that the most accurate results possible are obtained, samples must be processed within specified time periods. Analytical holding times have been established to allow sufficient time for sample processing without compromising sample integrity. It is important that, while meeting timeliness requirements, other data quality objectives are still considered and met.

**Documentation**

Complete and accurate documentation is essential for verifying the integrity of analytical results. Achievement of other quality objectives cannot be used to substantiate data quality without full documentation of the analytical process. Documentation must be concise and readily available for subsequent review.

The quality assurance program at ARI has been developed to ensure that the specified data quality objectives are met for all reported results and the highest degree of completeness possible is achieved.

### 1.2 Ethics Policy on Data Quality and Confidentiality

To ensure that data quality or confidentiality is not compromised, ARI has established the following policy on corporate ethics. Following are steps that must be taken when the quality or confidentiality of data is suspected or known to be compromised. This policy applies to all ARI employees at every organizational level.

**General**

ARI's corporate commitment to integrity and honesty in the workplace is clearly stated in the ARI Employee's Handbook, under "Standards of Conduct". The Standards of Conduct statement is attached as Appendix O. The ARI commitment to excellence in data quality extends to and includes all aspects of data production, review and reporting.

Any attempt by management or any employee to compromise this commitment presents a case for serious disciplinary action. Any indications or allegations of waste, fraud or abuse will be rigorously investigated by ARI management, with the penalties for verified cases to be employment termination, and if appropriate, prosecution. In addition to these steps, any such

charges related to data generated for the federal government will also be reported to the Inspector General of the appropriate department.

## Circumstances

All ARI employees will immediately report to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any associated components).

Misrepresentation of data includes (but is not limited to) the following:

*Altering an instrument, computer or clock to falsify time or output*
*Altering the content of a logbook or data sheet in order to misrepresent data*
*Falsifying analyst identity*
*Changing documents with correction fluid with the intent of falsifying information*
*Preparing or submitting counterfeit data packages or reports*
*Unauthorized release (either written or verbal) of confidential data*
*Illegal calibration techniques (peak shaving, fraudulent integrator parameters)*
*Any attempt to misrepresent data or events as they actually occur in the course of data production or reporting*

## Responsibilities

It is the responsibility of all ARI employees to report any situation which may be adverse to data quality or confidentiality, or which may impact the final data quality. All ARI employees have the obligation to discuss known or suspected violations of this policy with laboratory management, who in turn are obliged to inform the ARI Laboratory Manager. If a satisfactory resolution is not obtained or is not possible at laboratory level, all ARI employees have the right and responsibility to discuss the matter directly with the ARI Laboratory Manager.

It is the responsibility of the ARI Laboratory Manager to promptly investigate any reports of known or suspected violations. The ARI Laboratory Manager has the authority and responsibility to resolve all known or potential violations of the policy.

It is the responsibility of ARI management to provide all of its employees with the facilities, equipment, and training to achieve the quality goals stated in the policy. It is the responsibility of ARI to provide our clients with data of known and documented quality.

## Documentation

To reaffirm an awareness of and commitment to the highest standards of data quality, excellence, and integrity, all employees are required to sign the following "Commitment to Excellence in Data Quality" statement:

"As an ARI employee, I have the right and responsibility to report any situation which may be adverse to quality or which may impact the final quality or integrity of data produced for our clients."

"I will report immediately to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any of its associated components). Examples of this include (but are not limited to): alteration of an instrument computer or clock, alteration of the contents of logbooks and/or data sheets in order to misrepresent data, misrepresentation of analyst identity, intentional falsification of documents with correction fluid ("white-out"), preparation and submittal of counterfeit data packages, use of illegal calibration techniques (peak shaving, use of fraudulent integrator parameters, etc.), or any attempt to misrepresent data or events as they actually occur in the course of an analysis."

"I will likewise alert management of any situation or activity which may be adverse to the confidentiality of clients' data."

"I will not knowingly participate in any such activity, nor fail to report such activities of which I may become aware. I understand that any voluntary participation on my part in such activities may result in the termination of my employment, and possible legal prosecution."

"Where circumstances permit, I will report any actual or suspected violations of this policy to my lab or section supervisor. If a satisfactory resolution is not obtained or is not possible at that level, I have the right and obligation to discuss the matter directly with the ARI Laboratory Manager."

## Confidentiality

All information related to client projects, such as client work plans, documentation and analytical data will be considered confidential. This information will be released only to the client or an authorized representative. Should an outside agency request information related to a client project, the client will be contacted for approval prior to releasing any information.

Some programs or contractual agreements (such as the USEPA Contract Laboratory Program) may have specific requirements for protecting a client's confidentiality Project Managers will be responsible for strict control of access to any such confidential information or documentation. All data generated from the analysis of confidential samples will also be considered confidential.

# SECTION 2.0: QA MANAGEMENT AND RESPONSIBILITIES

The principal tenet of the Quality Assurance Program at Analytical Resources Inc. (ARI) is that every employee knows she/he is a vital component of the program, and holds a responsibility to produce high-quality, defensible data in a timely manner. While production of quality data is a global philosophy, held by the entire laboratory, each section is responsible for ensuring that the data produced within that section meets the required quality objectives.

## 2.1 Overall Structure

The Board of Directors shall direct ARI's QA Policy and shall determine the Philosophy of the QA Program. It shall be the responsibility of the Laboratory Director to translate this policy into practical procedures with respect to the business plan developed for ARI, and direct the Laboratory Manager and Section Managers regarding the incorporation of these procedures into daily laboratory activities.

The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. The Laboratory Manager will coordinate Client Services, Laboratory Section Management, Computer Services, and Data Services to ensure that project requirements and data quality objectives are met.

The Laboratory Section Managers and Supervisors shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QA Manager and Project Managers. Section Managers and Section Supervisors shall instruct employees in the proper employment of QA policies.

Each Section Supervisor will ensure that analyses are completed within required holding times, that data is submitted within required submission times, and all analyses are performed according to the current Standard Operating Procedures (SOPs). They will ensure that any client modifications or QA issues are well documented for each sample set and that all required documents are complete when submitted with each data set.

The analytical staff shall execute all methods following QA policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by

Section Managers and the Laboratory Director, and once approved will be submitted to the Quality Assurance Program Manager (QAPM).

The QAPM will be responsible for controlling Company SOPs and other internal documents, overseeing the scheduling and completion of detection limit studies. The QAPM will coordinate the production of control charts and distribution of control limit data to all laboratory sections. The QAPM will administer the blind QA proficiency tests and performance samples as described in the QA Program. The QAPM will verify that QA policies and procedures are followed through out ARI.

Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.

Computer Services is responsible for ensuring that the Laboratory Information Management System (LIMS) correctly reflects the preparations and analyses performed and that the LIMS is updated with the current SOP, MDL, RL and QL data as submitted from the QAPM. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that this data matches the hardcopy deliverables submitted.

Client Services (Project Management, Sample Receiving), shall be responsible for ensuring that the laboratories understand and can meet project specific analytical requirements and DQO.

## 2.2 Hierarchical Responsibilities

**Technical Director**

> *It shall be the responsibility of the Laboratory Director to translate QA policy into practical procedures with respect to ARI's business plan, and to direct the Laboratory Manager and Section Managers in the implementation of these procedures in daily laboratory activities.*

The Director shall interpret overall QA Policy, and determine the broad practicality of policies based on methodologies, technological advances, and the current environmental market. It

shall be the interpretation of these policies that will, in turn, direct the growth ARI, the addition or withdrawal of methods to ARI′s repertoire, and ARI′s marketing focus.

At a minimum of once a year the Technical Director shall include on the agenda of the Board of Directors meeting a discussion of ARI′s QA Policy. This discussion will include the reputation of ARI for producing quality analyses, the affect of QA policies on turn-around time, competitive edge and cost-of-analysis, needs for stricter or more flexible policies, and the response of employees to the QA policies in place at that time.

At a minimum of once every six the Director shall attend management meetings, which include on the agenda the subject 'QA Program'. This format will allow for the dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. Management shall also use these meetings to discuss requirements of clients that are not met by ARI′s present QA Program, and the appropriate response to these requirements.

The Technical Director may be required to act as a technical advisor at any impromptu meetings called by management to address QA issues that cannot be immediately resolved within a laboratory section.

It shall also be the Director's authority and responsibility to hold final review approval for all SOPs of ARI. Once an SOP has been updated and reviewed by the laboratory section, it shall go through the Section and Laboratory Managers for approval, and then to the Laboratory Director for final approval before the SOP is released.

**Laboratory Manager**

> *The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. It shall be the Laboratory Manager's responsibility to coordinate Client Services, Laboratory Management, Computer Services, and Data Services to ensure that QA Program requirements and data quality objectives are met.*

The Laboratory Manager is required to attend all management meetings, at which the QA Program will be an agenda item. Management shall use these meetings to discuss requirements of clients that are not met by ARI′s present QA Program, the appropriate response to these requirements, and dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors.

It is the responsibility of the Laboratory Manager, along with the QA Manager, Laboratory Director, Section Managers and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and those accreditations that ARI will pursue. It is the responsibility of the Laboratory Manager, with the Section Managers, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Laboratory Manager has the responsibility of balancing client requests and requirements with the QA policies of ARI. It is the Laboratory Manager's task to evaluate a client's Data Quality Objectives (submitted through Client Services), and with the Section Managers to determine the feasibility of laboratory performance. Feasibility will be based on the quality objectives requested, current QA Manual, present workload (in-house and scheduled/pending), the technology in place, and staffing levels available. Current workload in-house will be evaluated using reports from Computer Services, and scheduled/pending workload will be evaluated using written and verbal input from Client Services.

The Laboratory Manager has the authority to direct Client Services to discontinue the bidding/contracting process for a new project, refuse samples, or to re-schedule projects based on Data Quality Objectives or current workload. The Laboratory Manager also shall evaluate staffing and equipment needs based on information from the Section Managers and Client Services and may elect to meet new project requirements by increasing staffing levels or purchasing additional equipment.

The Laboratory Manager serves as a senior-level technical reference for all laboratory activities, and as such will be brought in to advise on out-of-control events and trends, corrective actions, and/or other QA issues that require his/her expertise.

## Laboratory Section Managers

*The Section Managers shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QAPM and Project Managers. Section Managers are responsible for correcting out of control events within their respective laboratories. Section Managers and supervisors shall instruct employees in the proper employment of QA Policies.*

Laboratory Sections Managers shall have the final authority in decisions concerning QA policy. It is their expertise that will determine the final acceptable format of each method SOP, as they are the best resource to integrate methods into ARI's philosophy.

Laboratory Section Managers are responsible for completing or delegating updates of laboratory procedures and quality assurance manual sections as scheduled by the QA Manager.

The Section Managers are best able to determine capacity of the Laboratory Sections. To ensure that analyses are completed within required hold times, the Section Managers will give Supervisors the authority to balance employee workloads and modify employee work schedules. It is the Section Manager's responsibility to take reports from supervisors and work with the Laboratory Manager to increase staffing levels or reject samples as needed. It is the Section Manager's responsibility to work with the Laboratory Manager and the section supervisor and analysts to ensure that sample capacity does not affect the quality of data generated from that laboratory section.

It is the responsibility of the Laboratory Section Managers, along with the QA Manager, Laboratory Director, Laboratory Manager and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and which accreditation processes ARI will pursue. It is the responsibility of the Section Managers, with the Section Supervisors, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Section Manager will be responsible for reviewing training records of analysts produced by the Section Supervisor. Training shall be the responsibility of the Section Supervisor, but it is the responsibility of the Section Manager to oversee this training.

It is the Section Managers' responsibility to work with the Section Supervisor and Project Manager to assure that Project Requirements are achievable and valid for the given methods. At times, ARI's clients have requests or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently performed by the laboratory, or 3) unachievable by the instrumentation used in the laboratory. It is the responsibility of the Section Supervisor,

Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

Clients may also request modifications to the methods that must be approved by the Section Supervisor, the Section Manager and the QAPM. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services, as needed for implementation.

The Section Manager is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts or Section Supervisor.

The Section Manager has the authority to re-classify analysts or require additional training of analysts based on their performance.

**Section Supervisors**

> *It is the responsibility of each section Supervisor to ensure that analyses are completed following the most current version of ARI´s SOP, within required holding and turn around times, and assure that analyses meet the Data Quality Objectives of each project. They will ensure that any client modifications or QA issues are well documented for each sample set, and that all documentation is complete when submitted with each data set.*

To ensure that analyses are completed within required hold times, the Supervisors have the authority to balance employee workloads and modify employee work schedules. The Section Supervisors, with the input of the Section Manager, have the authority to request overtime from employees should the workload warrant the additional effort, or to modify employee schedules to extend the operating hours of the laboratory section.

The Section Supervisors shall oversee the day-to-day section operations, using LIMS printouts and verbal or written workload estimates and requests from Project Managers to adjust section efforts as needed. It is also the Section Supervisors' responsibility to inform management (Section Manager, Data Review, and Project Managers), when capacities are limited, so that the appropriate adjustments can be made to reduce workloads or increase laboratory capacities. At no time should sample capacity be allowed to affect the quality of data generated from any laboratory section.

It is the Section Supervisor's responsibility to assure that employees have the proper training for their positions. This training will include training in the methods, use of the LIMS system if applicable, training in correct documentation procedures, and all information necessary for adherence to the ARI QA Program. The Supervisor shall either perform the training personally, or designate the trainer for given methods or procedures. It is the Supervisor's responsibility to test each employee for each method or procedure, and to thoroughly document each employee's advances and current capabilities. The Supervisor shall have the authority to require further training or supervision for any employee, and shall be the authority to approve each employee for working without supervision. There will be a training record for each employee. These will be kept in the laboratory section; copies will be submitted to the QA Manager for record keeping.

It is the Supervisor's responsibility to work with the Section Manager and Project Manager to ensure that Project Requirements are achievable and valid for the given methods. At times clients have requests and/or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently part of the method as performed by the laboratory, or 3) unachievable by the instruments used in the laboratory. It is the responsibility of the Supervisor, Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

It is the responsibility of the Section Supervisor to ensure that each analyst reads and understands all requirements submitted with each sample set, including those for any special analyte, calibration, or data deliverable. It is the Section Supervisor’s responsibility to clarify any issues, with the input of the Section Manager and the Project Manager for the client.

Clients also at times will request modifications to methods, which must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for implementation.

It is the Supervisor's responsibility to ensure that each employee understands the requirements of all projects they work with. This may necessitate section meetings or project-

specific cross-section teams to work with Project Managers for large, specialty projects to ensure that everyone has the same understanding of project requirements.

The Supervisor is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts, and for ensuring that the analysts complete all documentation. If the Supervisor and laboratory section analysts cannot resolve the issues in a timely manner, the Supervisor's will request the assistance of laboratory management to bring the section into compliance. The Supervisor will also inform Project Management and his/her Section Manager of possible delays, and inform Data Review of possible time constraints they may face in preparation of data submissions from the lab section.

The Section Supervisors shall have the authority, usually in consultation with Laboratory or Project Management to use professional judgment in requiring samples be re-prepared, and shall determine which analysts have the authority to require re-preparation of samples.

It is the responsibility of the Section Supervisor to inform the QAPM, Section Manager and the Computer Services section of any changes in methodologies that will require revision of SOPs, MDLs, Control Limits or the LIMS programming. This includes changes in spiking compounds, spiking levels, preparation methods and analytical methods.

## Analysts

> *The analytical staff shall execute all methods following QA Policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by Section Managers, the Laboratory Manager, and the Laboratory Director, and once approved will be submitted to the QA Manager.*

The analysts are responsible for following the current SOPs (with project-specific modifications if required) in preparing and analyzing client samples and quality control samples to meet the project specific Data Quality Objectives. It is the analyst's responsibility to ensure that he/she understands all requirements of a project before proceeding with sample preparation or analysis.

Analysts are responsible for working with the Supervisor to ensure that all sample preparations and analyses are performed within required holding times and required turn-around times, and that all documentation is completed in a timely fashion. It is each analyst's responsibility to bring any recurrent or anticipated problems to the attention of laboratory management.

It is each analyst's responsibility to correct his/her own errors, to document corrective actions thoroughly, to perform peer review, and to ensure that fellow employees within the section follow documentation procedures.

The Section Supervisor may give lead analysts responsibility for training and evaluation of new staff members. This training will include instruction in the methods, use of the LIMS system if applicable, correct documentation procedures, and all information necessary for adherence to the ARI QA Program. Analysts will be responsible for maintaining all instruments and equipment in optimum operating condition and documenting this maintenance as required by the QA Program.

It is the responsibility of each analyst to request the assistance of Supervisors or Managers in resolving out-of-control situations that cannot be corrected in a timely manner, and to perform the documentation of all corrective action activities.

**Quality Assurance Program Manager (QAPM)**

> *The QAPM will be responsible for controlling Company SOPs and other internal documents. The QAPM will oversee the scheduling and completion of detection limit studies and control charts. The QAPM will administer the training program, analyst's proficiency documentation and performance evaluation analyses as described in the QA Program. The QAPM will verify that QA policies and procedures are followed at all levels in the Company. The QAPM will produce a "Quality Assurance report to Management" each calendar year.*

The QAPM is responsible for the oversight of the QA Program as defined by the Board of Directors and interpreted by the Laboratory Director and Laboratory Managers.

Part of this oversight will be monitoring of the QA Program through submission of performance evaluation samples, blind QA samples and double-blind QA samples. It is the responsibility of the QAPM, along with the Laboratory Manager, Laboratory Director, Section Managers and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate. The QAPM will be responsible for submitting these samples to the laboratory for analysis, overseeing submission of the results to the appropriate agencies, and for control of documented proficiency results.

The QAPM will be responsible for scheduling laboratory section SOP and procedural reviews and revisions, and section updates of the Quality Assurance Manual. It is the responsibility of

the QAPM to work with each Section Manager to attempt to stagger these review schedules across the year within each laboratory section. The QAPM will also be responsible for maintaining document control of all SOPs, bench sheets, logbooks, and other forms used within the laboratory.

All laboratory sections, on an annual basis, will perform detection limit studies for each method used within each section. It is the responsibility of the QAPM to schedule, review, compile, and distribute the results of these studies.

The QAPM is responsible for evaluation of the laboratories' adherence to defined protocols through periodic audits of completed projects and of the laboratory facilities. Following the audit schedule (Appendix K), the QA Manager will perform the scheduled audit and prepare an evaluation that will be submitted to the Board of Directors in the Annual QA Report to Management.

The QAPM will be responsible for evaluation of outside accreditation requested by Client Services. The QA Manager will deliberate with the Laboratory Managers and Laboratory Director on the feasibility of pursuing accreditation based on the scope of the accreditation, the effort required to pursue accreditation and the scope of work that might become available once the accreditation is obtained. If a decision is made to pursue an accreditation, it is the responsibility of the QAPM to coordinate laboratory efforts towards the accreditation.

The QAPM will produce an annual "Quality Assurance Report to Management" to be distributed to ARI management personnel as described in Section 13 of this LQAP.

The QAPM will serve as a resource for quality-related issues for all Laboratory Sections, and will serve management in an advisory capacity.

The QAPM will have documented training in elementary statistics and Quality Systems theory.

**Data Reviewers**

*Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.*

Data reviewers shall ensure that all samples are analyzed according to approved methods by reviewing the data released by each laboratory section. The data will be evaluated for compliance with all Data Quality Objectives as defined in the method SOP or in the project-specific quality assurance plan, including instrument tuning and calibration, holding time, spiking level, and spiking recovery criteria. Data reviewers will also verify 100% of manual calculations, spot check computer calculations, check electronic data for correct sample matching, and do a 100% check on any manually entered data. Analytical parameters, which have concentration interdependence, will be evaluated in relationship to each other.

Final reports generated will be evaluated to ensure that laboratories are using the current detection limit/reporting limit values and the current control limits. Data will be checked to ensure that all QA issues are addressed and fully documented. Reviewers are responsible for working with Laboratory Supervisors, Laboratory Managers and Project Managers when out-of-control events are incompletely documented, or if data is found to not meet Data Quality Objectives of a project without documentation.

It is the responsibility of data reviewers to work with Computer Services to ensure that the LIMS is updated to the current limits and methods used within the laboratory.

**Computer Services**

> *Computer Services is responsible for ensuring that the LIMS correctly reflects the preparations and analyses performed and that the LIMS is updated to include the current SOP, MDL, RL and QL data, as submitted by the QA Manager. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that electronic data matches the hardcopy deliverables submitted.*

It is the responsibility of the Computer Services Manager to update, or to designate the task of updating, the LIMS as determined by Laboratory Management, including adjustment to current MDL/RL data, additions of analytes to methods, changes in method designations or changes in calculations for methodologies.

Computer Services will be responsible for generating the work list scripts required to allow analysts to enter data into the LIMS, and for generating the report scripts that produce final hardcopy or electronic reports for clients.

Computer Services Management and personnel are also responsible for generation and review of electronic data deliverables (EDD), as requested by clients through Project Management. Computer Services personnel will review the EDD for compliance with the Software Quality Assurance SOP before it is released to the client.

Computer Services will be responsible for informing laboratory Section Managers and Project Managers of any discrepancies found between the EDD and the hardcopy, and for following up on corrections to hardcopy and EDD as required.

## Client Services

> *Client Services (CS) (Project Managers, Sample Receiving, and Sales Management) personnel are the primary interface between ARI's clients and the laboratory sections. CS staff shall be responsible, with the assistance of the Section Managers and Supervisors, for ensuring that the laboratories understand and can meet the Data Quality Goals and Requirements of each Project before committing laboratory services to the project. CS will monitor the quality of sample processing after they are received.*

Client Services Management and Project Managers shall ensure that the laboratories can meet the data quality objectives for a project. The Project Managers are responsible for knowing the capabilities of the laboratory, in order to develop project proposals or accept samples without consultation with laboratory management. It is the responsibility of Client Services to consult with the Laboratory Manager and Section Managers, or supervisors designated by Management, when data quality goals are not included in standard Company policies. Clients may, at times, request modifications to methods that must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for verification of feasibility. Laboratory Management may determine that a project should not be pursued based on the specific Data Quality Objectives and on current or projected laboratory capacity.

Project Managers shall be responsible for ensuring that project requirements and analytical requests are submitted correctly to all laboratory sections. Once samples have been logged into the laboratory, it is the responsibility of the Project Managers to ensure that all information is available to the laboratories concerning the Data Quality Objectives and deliverables

requirements. It is also the responsibility of the Project Managers to convey changes in client requirements to the laboratories and ensure that all paperwork reflects the changes if necessary.

It is the responsibility of Project Managers and Client Services Management to assure that specific EDD formats are submitted to Computer Services and approved as feasible before contracting with a client to provide the EDD.

It is the responsibility of Project Managers to notify clients of out-of-control events, “problem” samples, or anticipated turn-around time delays, as conveyed to them by Laboratory Management. It is also the responsibility of Project Management to work with Laboratory Management in setting priorities during times of heavy sample workloads.

Project Managers shall be responsible for coordinating data submissions and compiling hardcopy data for final submission to the client. This involves conducting a fourth level data review, from which any data which is found to contain errors that were not found earlier in the review process is returned to the Data Reviewer for correction and/or corrective action. The Project Manager will be responsible for compiling all analyst notes into a project narrative. This will include discussion of any sample receipt discrepancies, sample preparation and analysis difficulties or non-compliance, and any corrective actions that may have been required during processing. It will also discuss quality control analyses and results if applicable to the sample set.

Project Managers shall work with Laboratory Management in determination of the direction of growth for ARI, as the Project Managers are best able to define the analytical needs of clients based on new technologies and new environmental regulations.

# SECTION 3: PERSONNEL QUALIFICATIONS AND TRAINING

The production of quality analytical data is dependent upon a laboratory staff with qualifications and training necessary to perform assigned tasks. All personnel employed by ARI will receive adequate training and instruction specific to their responsibilities. Prior to assigning a staff member full responsibility for performing a laboratory procedure, her/his skills will be evaluated and verified acceptable. It is the obligation of ARI's supervisors and managers to ensure that personnel are qualified to successfully perform all assigned duties.

ARI's training program is described in SOP 1017S (*Training and Demonstration of Proficiency*). The procedures described in this SOP assure that all ARI employees are proficient at the tasks required to produce quality analytical data. The SOP also provides for periodic review of each employees training and proficiency status, which may indicate any need for additional or remedial training. All training and review procedures are documented as described in the SOP. Appendix B of this document includes specific requirements of the training program and examples of the forms used to document training.

Basic elements of ARI's training program are:

1. All employees are required to read and document their knowledge of non-technical documents that describe general policies in place at ARI. These documents include ARI's *Employee Manual* and ARI's *Chemical Hygiene Plan*.
2. All employees are required to read and document their knowledge of ARI's *Laboratory Quality Assurance Plan* and quality assurance policies.
3. All new employees must attend a Quality Assurance Orientation during which ARI's general and specific requirements for the production of quality analytical data are emphasized. A typical orientation agenda is included in Appendix B.
4. All new employees will attend a Technical Orientation conducted by their laboratory supervisor or manager. The technical orientation is used to provide specific information about laboratory operation to the employee and to assess the new employee's education

and skill level. The section supervisor or manager is responsible for determining the level of training necessary for each staff member.

5. All employees will complete an 'on the job' training program designated by their supervisor. The training program will be laboratory, SOP and employee specific. Training programs follow the general outline provided in Appendix B. The training is incremental with each step documented in an employee Training File. While an analyst is in the training period, her/his supervisor or trainer must approve all analytical work. Upon completion of the training program the employee is considered proficient and may perform without supervision the SOPs listed in the training program.
6. The proficiency of each employee performing a given laboratory SOP will be continually monitored and documented as described SOP 1017S. An employee must continually generate data that meets all of ARI's published acceptance criteria for a given SOP to be considered proficient. Unacceptable results or insufficient number of analyses performed in a calendar quarter will result in revocation of proficiency. This will result in a remedial training program.
7. Periodically, as described in SOP 1017S, internal and/or external Performance Evaluation (PE) samples will be used to document staff competency. Technicians and analysts will participate in the preparation and analysis of blind samples for all methods they routinely perform. Results of these blind samples will be evaluated to verify staff proficiency. Staff members associated with acceptable performance evaluation samples will be considered proficient for those methods. Conversely, unacceptable performance evaluation sample results may signal the need for additional or remedial training.
8. A training file is established for each technical employee. The file will document an employee′s experience, training and proficiency. The training file will document each specific PE sample analysis performed by an analyst. Either an employee′s supervisor or Quality Assurance Program personnel will update the training file. The training file will be maintained in the employee′s laboratory as outlined in SOP 1017S.

# SECTION 4: FACILITIES AND EQUIPMENT

## 4.1 Facilities

ARI's facilities have been designed to allow for efficient sample processing and analysis while maintaining consideration for the health and safety of the staff. The facility accommodates the following operations:

*Sample receipt and storage*
*Sample container preparation and shipment*
*Sample preparation and analysis (organic and inorganic)*
*Project planning and management*
*Quality assurance*
*Data review and report generation*
*Computer programming and operations*
*Records storage*
*Instrument spare parts storage*
*Short-term hazardous waste storage*

A detailed description of ARI's facilities is included as Appendix C.

## 4.2 Security

### Facilities

To ensure that security at ARI is maintained, access to the facilities is limited to employees and escorted visitors. Upon arrival, ARI visitors are required to register at the reception desk, and must sign out prior to leaving. Visitors will be escorted at all times. A receptionist constantly monitors the main entrance. Other laboratory entrances remain closed at all times and can only be opened from the outside by key. Key access to the facility is controlled; keys are issued on a limited basis depending on access needs.

As a result of controlled access and a monitored alarm system, the entire facility is considered a secure area. This eliminates the need for locked sample storage refrigerators, data storage areas or file cabinets.

### Data Access

The Computer Services Manager controls security of, and access to, electronic data on the LIMS. Security measures are required to ensure data integrity, but must not be so restrictive

as to prevent data accessibility. The security measures taken at ARI are to prevent intentional intrusion by outside parties. These measures include building security, limited computer system access, password systems, encryption, firewalls and the use of virus protection programs. ARI's Intranet is protected from outside tampering by a proxy server (firewall) connection to the Internet.

**LIMS - System Security**

Building/Computer Room Security

Access to the building is restricted to employees, vendors with security passes, and escorted visitors. Room 203 contains the computer and main console for the LIMS system. This room is closed and locked at all times. Access to this room is limited to Computer Services personnel, escorted repair technicians, and escorted visitors. Only Computer Services personnel will be allowed access to the main console.

System Password Policy

User name and password restrict access to the LIMS computer. Remote access to the LIMS server is not allowed.

Database Access Restrictions

Interaction with the database is menu-controlled and allows the LIMS Manager to restrict access. Technicians may be given the ability to fill a limited number of work lists, with no authorization to distribute data. Some users may be given "read only" access to the database.

Users will be given access to the database only to complete tasks for those analyses for which they are responsible. No users are to be given access to the shell or command prompt unless 1) they have completed the appropriate training and 2) administrative access to the computer systems is required by their job function

### 4.3 Safety

Ensuring that all sample processing and analysis procedures are performed under safe conditions is an important consideration at ARI. While safety is the responsibility of all staff members, ARI's Safety Committee meets monthly to review the safety activities of all laboratory sections and to ensure that all operations and equipment meet safety criteria. *The*

*Chemical Hygiene Plan* details those safety procedures and requirements that must be followed at ARI. *The Chemical Hygiene Plan* is reviewed annually and updated as needed to incorporate any changes to ARI's safety program.

## 4.4 Instrumentation and Support Equipment

### 4.4.1 Instrumentation

Generation of quality data is dependent upon instrumentation and support equipment that is in optimum operating condition. All instrumentation will be optimally maintained per method requirements and manufacturer recommendations. Preventative maintenance will be performed on a routine basis, with more frequent maintenance during periods of increased sample load or after analysis of highly contaminated samples. Preventative maintenance is instrument and analysis specific, and each maintenance logbook has been designed specifically for the instrument type. Required maintenance procedures are listed in analytical SOPs. Each maintenance logbook will detail the type and frequency of maintenance for that instrument. Each maintenance logbook is kept with the instrument. Non-routine maintenance and repairs will be performed as necessary. Spare parts are kept on hand when possible; necessary parts are ordered on an expedited basis to minimize downtime. All maintenance and repair activities will be documented in the appropriate logbooks.

Currently available Laboratory Instrumentation is detailed in Appendix C.

### 4.4.2 Support Equipment

4.4.2.1 Thermometers - – All thermometers in use at ARI are traceable to an NIST standard and are calibrated or verified annually. The procedures are described in SOP 1020S.

4.4.2.2 Water Baths, Incubators and Ovens – The temperature of water baths and ovens currently used in the analytical process are monitored daily. Temperatures are recorded on temperature logs that are audited monthly by Quality Assurance personnel. Temperature controls on these devices are calibrated annually by an outside vendor. Calibration reports are filed in the QA Office.

4.4.2.3 Refrigerators and Freezers - Refrigerators and freezers are assigned an acceptable operating range of temperatures. The temperature is monitored daily. Corrective Action is required for all out of range temperatures.

4.4.2.4 Balances – The accuracy of all balances is verified prior to daily use with two Class S weights that bracket the normal weighting range of the balance. All analytical balances are professionally cleaned and calibrated annually by an outside contractor. Class S weights are calibrated every three years by an outside contractor. Calibration reports are filed in the QA Office.

4.4.2.5 pH Meters – pH meters are standardized prior to daily use with at least two standards, one at 4.0 and one at 7.0 pH units. The meters are checked prior to each use with a pH 7.0 buffer.

4.4.2.6 Variable Volume Pipettes – The accuracy of variable volume pipettes is verified monthly following the procedure in SOP 1015S.

4.4.2.7 Sample Containers – Upon client request ARI will supply sample containers for collection of field samples. All containers supplied for organic and trace metals analyses are certified pre-cleaned by the manufacturer. Containers for Conventional analyses are not pre-cleaned and are certified internally by ARI following the procedures in Appendices of ARI SOP 001S (Sample Receiving). The manufacturer's certification may be above ARI's reporting limit for some analyses. When this is the case ARI performs a Method Blank analysis using a container from a given lot and certifies that the lot is suitable for sample collection.

Container lot numbers are recorded when containers are sent to a client.

### 4.4.3 Chemical Standards and Reagents

#### 4.4.3.1 Reagent Water Supply

ARI maintains a centralized water purification system. The quality of the water produced is monitored and documented daily. Routine maintenance, out of control events and corrective actions are documented for each system in a logbook. All reagent / de-ionized water used within the laboratory meet or exceed ASTM Type II Standards. Water used in the Volatile Organic Laboratory is also filtered through activated charcoal to remove organic compounds. .

#### 4.4.3.2 Chemical Standards

All quantitative standards used for calibration in an analytical process are traceable to a National Institute of Standards & Technology standard if one exists. Non-traceable standards are verified against traceable standards or through the analyses of Standard Reference Materials. A Certificate of Analysis is filed in the QA Section or laboratory for all quantitative standards. The source, date of receipt, required storage conditions and an expiration date will be documented for all standards. All containers used to store standards will be labeled with an expiration date. Receiving, storage and preparation of calibration standards is described in SOPs 526S (Metals Analysis), 620S (Conventional Analysis), 704S (Volatile Organic Analysis) and 1012S (GC and GC-MS Analyses).

#### 4.4.3.3 Chemical Reagents

Many of the analytical processes in use at ARI require chemical reagents that are not directly used in the calibration process. These reagents are used to accomplish such tasks as analyte preservation, adjustment of pH, the forming of colorimetric indicators, etc. These reagents are purchased in a grade and purity sufficient for their intended use. The receipt of all reagents is recorded in the Chemical Receiving Logbook where a unique Inventory Number is assigned to each reagent. Each original reagent container is labeled with an Inventory Number, the date it is opened and an expiration date as appropriate. A Certificate of Analysis is obtained for reagents when available and archived in the QA Office.

Solutions prepared from reagents are recorded in the Reagent Preparation Logbook. The logbook includes a unique Reagent Number that is traceable to the Chemical Receiving Logbook. Reagent containers are labeled with Reagent Number, date of preparation, expiration date, and preparer′s identification.

Procedures for Reagent Receiving and Preparation are detailed in SOP 1013S.

#### Trace Metals Acids

To ensure the quality of acids, nitric and hydrochloric, used for trace metals analyses, only the highest quality, certified “metals free” acids are purchased. Each lot received is analyzed for purity prior to use in the laboratory to assure that it is acceptable for use. Whenever possible,

entire lots will be reserved for use exclusively by ARI. This minimizes the possibility of receiving contaminated or unacceptable acid.

**Solvents**

To ensure the quality of solvents used for sample preparation and analysis, the highest purity of solvents required for sample processing will be used. Purity checks will be performed on solvent lots received by the laboratory. Only those solvent lots determined acceptable will be used for sample processing. Whenever possible, entire solvent lots will be reserved for use. This minimizes the possibility of receiving contaminated or unacceptable solvents.

**Compressed Gases**

To reduce the possibility of system contamination, compressed gases and liquids used for operating analytical instrumentation will be of a specified purity level. Any cylinder suspected of introducing contamination into a system will be promptly replaced.

## 4.5 Computer Systems

ARI maintains several data systems. These are used to automate such diverse functions as accounting, payroll, sales and marketing, sample receiving, instrument data collection, production of hardcopy and electronic data deliverables, intra- and internet applications and project management. Specific information about these systems is contained in Appendix C and various SOPs.

ARI maintains a Laboratory Information Management System (LIMS) that stores analytical data, calculates final results and produces final reports (both hardcopy and electronic). The LIMS system is the major data system used at ARI. A separate Software Quality Assurance Plan outlines the QA/QC procedures for the LIMS system.

# SECTION 5: LABORATORY DOCUMENTATION AND RECORDS

All laboratory operations and procedures performed during sample processing are documented in logbooks, notebooks and on laboratory forms and bench sheets. Analytical data and copies of paper documents are also stored electronically. Consistent use of standard documents throughout the laboratory ensures that all activities will be traceable and serves as objective evidence of the work performed.

All procedures performed at ARI will be detailed in Standard Operating Procedures (SOPs). Sample preparation and analysis SOPs will reference approved analytical methods and detail the actual procedures followed by ARI staff. SOPs for non-analytical activities will detail the procedures developed specifically for use at ARI.

## 5.1 Responsibilities

All staff members are responsible for complete and accurate documentation of laboratory activities. Each laboratory section develops a comprehensive set of documents (bench sheets, forms, etc.) to record all activities performed in that section. All staff members are responsible for reviewing and understanding SOPs, and must sign a record to document this fact. The QAPM is responsible for maintaining control of laboratory documents and ensuring their consistent use.

To ensure that all documents, SOPs in particular, accurately reflect the activities performed at ARI, section supervisors and managers are required to review all documents annually and recommend changes to the QAP. The QAPM is responsible for coordinating document revisions and ensuring that all staff members have access to the most current laboratory documents.

## 5.2 Document Control

ARI's Quality Assurance Program requires that all forms and SOPs used within the laboratory be monitored to ensure that only the currently approved version of the documents are in use, centrally organized, and readily available to all staff members. All documents will include a

revision date. The LQAP and SOPs will also have an effective date. The time between the revision and effective dates will be used for training and orderly implementation of changes.

Electronic copies of laboratory documents will be maintained as part of the quality assurance files. Each laboratory section maintains working copies of pertinent forms and SOPs. The QAPM coordinates the generation of new forms or SOPs and modifications to existing documents. Log number assignments will be as follows:

| Laboratory Section | Form Number | SOP Number |
|---|---|---|
| Client Services | 0001 - 0999 | 001 - 099 |
| Computer Systems | 1000 - 1999 | 100 - 199 |
| Data Services | 2000 - 2999 | 200 - 299 |
| Extractions | 3000 - 3999 | 300 - 399 |
| GC Laboratory | 4000 - 4999 | 400 - 499 |
| Metals Laboratory | 5000 - 5999 | 500 - 599 |
| Conventional Laboratory | 6000 - 6999 | 600 - 699 |
| Volatile Organic Laboratory | 8000 - 8999 | 700 - 799 |
| Semi-volatile Laboratory | 7000 - 7999 | 800 - 899 |
| Quality Assurance Monitoring | 10000 - 10999 | 1000 - 1099 |
| GeoTech Laboratory | 11000 - 11999 | 1100 - 1199 |

Document numbers will be include an F for forms and an S for SOPs i.e. 101F or 1234S. Document Control Logs of all forms and SOPs, detailing the form name and number, revision number and revision date will be maintained by the QA Officer. Outdated documents will be maintained in an electronic archive file.

The QAPM will distribute new and revised documents to the appropriate laboratory sections. Section staff will replace outdated copies of the document with the revised version. Laboratory forms and SOPs will be generated or revised on an “as needed” basis, and will be reviewed and revised as at least annually. Only the latest version of a form or SOP will be available in each laboratory. Section supervisors will periodically review these documents and recommend

changes to be implemented by the QAPM. A comprehensive review of all laboratory documentation will be performed annually at the direction of the QAPM.

To maintain document security, release of documents to clients or other outside agencies will be controlled by the QAPM. The QAPM will record the document to be released, revision number, person and agency receiving the document, and the release date. All documents generated by the laboratory will be considered proprietary. ARI permission must be obtained by anyone releasing the document to other agencies or including the document in a project or quality assurance plan.

### 5.3 Reference Documentation

To provide an understanding of the procedures employed to generate quality data, a comprehensive set of reference materials is available to staff members. All activities performed within the laboratory can be referenced to a method or SOP. The laboratory maintains copies of the following method compilations:

*Code of Federal Regulations (Section 40)*
*Test Methods for Evaluating Solid Waste (USEPA SW-846)*
*USEPA Contract Laboratory Program Statement of Work for Organics Analysis*
*USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis*
*Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series methods)*
*Standard Methods for the Examination of Water and Wastewater*
*Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)*
*US Naval Facilities Engineering Support Activity –NFESC (formerly NEESA).*
*Hazardous Waste Remedial Actions Program (HAZWRAP)*
*State of Alaska Department of Environmental Conservation (ADEC)*
*Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods*
*Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)*
*Washington State SARA*
*AFCEE Project Quality Assurance Plan*
*Washington State EPH/VPH Methods*
*National Environmental Laboratory Accreditation Conference*
*Department of Defense Quality Systems Manual*
*Washington State Sediment Sampling and Analysis Plan*

Other methods followed within the laboratory are also available. Published modifications to analytical methods will be reviewed and incorporated into laboratory SOPs. If a method for a parameter is developed by ARI, it will be detailed in an SOP. SOPs will be available for all

laboratory activities. Each laboratory section will maintain a file or notebook of SOPs pertinent to that section. A compilation of all laboratory SOPs is maintained as part of the Quality Assurance Program files. A listing of laboratory SOPs is included as Appendix E.

The Quality Assurance Manual provides an overview of the laboratory-wide Quality Assurance program. A copy of the Quality Assurance Manual is distributed to all laboratory sections. Distribution of the QAP is coordinated by the QAPM.

ARI maintains a file of various laboratory and environmental publications and reference texts. These reference materials are available to all staff members. Operation and maintenance manuals are available for all equipment and instrumentation used within the laboratory. Additionally, senior level staff members are available to serve as reference sources. These staff members have numerous years of pertinent experience and can provide insight and guidance for all procedures and laboratory activities.

### 5.4 Quality Assurance Policies

Quality Assurance Policies provide standards and procedures to guide ARI employees in proper implementation of the QA Program. Appendix P includes current QA Policies.

### 5.6 Worksheets and Logbooks

Use of Laboratory Forms and Logbooks

All activities noted on laboratory forms and logs will be recorded in blue ink. Initials of the staff member performing the activity, as well as the date the activity is performed will be noted on all forms and logs. Any supplementary information about the activity, such as unusual observations or suspected procedural errors will be noted on the forms and logs. Laboratory logbooks will be prepared and controlled by the QAPM or his/her designee.

Changes to existing information will be annotated by drawing a single line through the original entry and initialing and dating the deletion. Correct information will be written above the deleted entry. When appropriate to clarify the intent of the change a note describing the reason for the change will be added. The use of correction fluids or other techniques that cover the entry in its entirety are not used on laboratory documents.

Since sample processing within an analytical laboratory involves many detailed steps, documentation can be quite extensive and varied. The following guidelines will be followed to encourage consistency in laboratory record keeping:

Standard Logbooks

Preparation of all stock and working standards is documented in the appropriate standards logbook. Each entry includes preparation date, initial and final concentrations (including solute and solvent amounts), standard ID number, expiration date and the identity of the person preparing the standard. Stock solution entries include standard lot number and supplier. Working solution entries include the stock solution ID number. Commercially prepared stock standards are recorded in the stock standard logbook.

Sample Storage Temperature Logs

The temperature of all refrigerators and freezers used for sample and standards storage is monitored daily. The temperature and recorder's initials are recorded on the temperature log attached to each unit. The acceptable temperature range for each unit is noted on the log sheet. Any out of control temperatures and/or corrective actions, must be noted on the log sheet and reported to appropriate personnel (Lab Supervisor and QA Manager)

Balance Calibration Logs

The true and measured values for each calibration check weight are recorded, along with the date and recorder's initials. Any actions taken, such as notifying the QAPM of malfunctions is indicated alongside the entry for that date.

Instrument Logs

The Instrument Run Logs must detail all samples analyzed on a given instrument for a given parameter. Instrument conditions, analysis date, analyst initials and standard or sample identifications in the analytical sequence must be recorded in the log. Comments related to sample analysis and minor maintenance are noted on the instrument logs. For GC/MS analyses, instrument performance is documented by recording internal standard response alongside the sample identification.

Sample Preparation/Analysis Worksheets

Sample preparation and analysis activities are documented on appropriate worksheets. Sample identifications, weights or volumes used, intermediate cleanups, final volumes, preparation dates and analyst initials will be noted as well as any observations about sample condition. Any issues encountered during sample preparation are also noted. Surrogate and spiking solution ID numbers, and concentrations added to the samples, must be indicated on the bench sheet.

For some parameters, analytical results are summarized on an analysis worksheet. Sample identifications, sample preparation information, sample results, quality control results, analysis date, analyst initials and reported detection limits must be indicated on the worksheet. Any necessary data qualifiers are also noted on the worksheet.

Maintenance Logs

All major maintenance performed on instrumentation or laboratory equipment must be documented. Maintenance performed, date and analyst performing the maintenance, and steps taken to verify that the maintenance was successful are detailed in the log. Routine maintenance of GC-MS instruments is documented on “maintenance cards” attached to each instrument. The demonstration that GC instruments are in-control following maintenance is documented in the instrument run log.

Individual Laboratory Notebooks

Staff members preparing USEPA CLP samples must maintain unique laboratory notebooks for these analyses. Each case submitted is documented on a separate, sequentially numbered page. A listing of all samples prepared as part of the case, the date and the preparer’s initials, and any notes specific to sample preparation must be annotated in the logbook. Individual notebooks are used only when required by a specific contract. All sample preparation information is recorded on a laboratory bench sheet.

## 5.5 Document /Data Storage and Archival

Logbooks

All active logbooks will remain in the appropriate laboratory sections. Completed logbooks will be forwarded to the QAPM for archival.

Magnetic Tapes and Diskettes

When instrument capabilities permit, all data generated is archived and stored on magnetic tapes or disks. The electronic media remains on file for approximately two years.

Chromatograms and Instrument Documentation

Electronic or paper copies of chromatograms, instrument calibrations, quantification reports and any other printed documentation generated during sample analysis are maintained as part of the permanent data files. All hardcopy data remain on file at ARI for five (5) years or longer as specified by contract.

Project Data and Documentation

Project data and support documentation, electronic or paper copies, will be filed a minimum of five (5) years, or as specified by contract.

# SECTION 6: SAMPLE CONTROL

All samples analyzed by the laboratory will be monitored in accordance with sample control procedures. Sample control includes operations such as container preparation, sample collection, receipt and storage, and tracking of the sample throughout all processing steps. Documentation of all sample control activities and adherence to standard procedures is an important aspect of ensuring that data quality objectives are met.

## 6.1 Sample Collection

Production of quality analytical data begins with proper sample collection. Improper sampling procedures may result in inaccurate final results. Although the laboratory is not routinely involved with sample collection, it will minimize the possibility for error by providing clients with appropriate sample containers and sampling instructions for the requested parameters. If, upon receipt, sample integrity appears to be compromised, the client will be immediately notified to allow for re-sampling if necessary.

## 6.2 Sample Container Preparation and Shipment

To minimize the possibility of contamination from containers furnished by outside sources, the laboratory will furnish all necessary sample containers for client projects when requested by the client. Sample containers, pre-cleaned to EPA specifications, or certified clean by the manufacturer or ARI, are supplied for most parameters. Containers for special purposes may be acquired upon request. Lot numbers for containers are tracked to link bottle orders to lot numbers.

A blank sample label is affixed to each sample container prior sending the container to a client. The sample label allows for recording of the following information at the time of collection: client name, client sample identification, sampling site, date and time of sample collection, analytical parameters, and any preservatives used. Sample labels provided by ARI are coated to prevent bleeding of recorded information if labels become wet.

To ensure that the correct number of appropriate sample containers are prepared and submitted to the client, a Bottle Request is completed by a Client Services staff member or Project Manager at the time sample containers are ordered by the client. All necessary

preservatives are also noted on the Bottle Request. The Bottle Request is then forwarded to appropriate personnel in the Sample Receiving Section for order preparation. All required containers will be gathered and preservatives added as specified. A copy of the Bottle Request accompanies the sample containers to allow the client to verify that the order is properly filled. Additional containers will be supplied for quality control purposes and in case of container breakage or sampling complications. A complete listing of containers and preservatives used within the laboratory is included as Appendix F.

To facilitate transportation of containers to the sampling site, sample containers will be placed in coolers along with appropriate packing material. The inclusion of packing materials, such as vermiculite or "bubblewrap", is provided to minimize the possibility of container breakage and cross-contamination. Sample containers will be organized in the coolers per analytical or client specifications. Depending on client preference and project requirements, coolers and sample containers will be shipped to a specified location, delivered by ARI courier, or held at the laboratory for pick up. To ensure that sample identification, analytical parameters, and sample custody are properly documented, Chain of Custody records will accompany all sample container shipments. When appropriate, as for drinking water source sampling events or for parameters that require preservation in the field, sample collection instructions will also be included with shipments.

### 6.3 Sample Admission

All samples received by the laboratory are processed in a central Sample Receiving area. To ensure the safety of staff members receiving samples, coolers will be opened under a hood or in a well-ventilated area. Appropriate protection, such as disposable gloves, safety glasses and laboratory coats will be worn during sample receipt and log-in. Additionally, all general safety practices as specified in ARI's Chemical Hygiene Plan will be employed.

Upon receipt, sample coolers will be inspected for general condition and custody seals. Time and date of sample receipt, as well as identification of the staff member receiving the samples, will be indicated on each Chain of Custody record accompanying the shipment. Cooler temperatures will be determined using an IR temperature measuring device or by placing a thermometer in the cooler immediately after the cooler is opened. If samples cannot be logged-in within 30 minutes after receipt, the sample coolers will be tagged and placed in the

walk-in sample storage refrigerator for short-term storage. Chain of Custody records for the stored coolers will remain in Log-In to ensure that processing of the stored samples is not overlooked.

Samples to be processed will be removed from the coolers and organized by sample identification. The number and type of sample containers received will be verified against the Chain of Custody record. Each sample container will be examined to verify that the condition is acceptable and that sample integrity has not been compromised during shipment. Sample containers broken during shipment should be handled according to procedures detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

After sample organization and initial inspection has been completed, sample information will be entered into the LIMS, and a Service Request will be generated for the sample set. The Service Request serves as a work order for the laboratory. The Service Request will contain the following information:

*Client Name*
*Client Project Name and/or Number*
*Client Contact*
*Verified Time of Sample Receipt (VTSR)*
*Required Turnaround Time*
*Laboratory Job Number*
*Client Sample Identifiers(s)*
*Laboratory Sample Number(s)*
*Required Parameters*
*Additional Analytical Requirements/Comments*

Also entered into the LIMS are the number of sample containers for each sample, sample conditions, and cooler temperatures.

A sequential laboratory job number will be assigned to each sample set. Laboratory sample numbers, determined by the job number and a sequential letter, will be assigned to each sample. Containers for each sample will also be numbered sequentially. The accuracy of sample container labeling is verified by a second person. These identifiers will be used to monitor the sample set and container throughout sample processing. All samples logged for the sample set and the analytical parameters required for each sample will be indicated on the Service Request. Client specific quality control requirements and any other pertinent

information indicated on the Chain of Custody Record will also be noted. Discrepancies between the Chain of Custody record and sample containers will be noted, as well as discrepancy resolutions. To reduce the possibility of inaccurate sample processing, the sample receiving staff working with the Project Manager will resolve all noted discrepancies prior to releasing the samples to the analytical sections.

Upon completion of sample log-in, all documentation will be placed in a master folder and forwarded to the assigned Project Manager for review and approval. The master folder will be color-coded as follows:

| Master File Color | Designation |
|---|---|
| Red | Accelerated Turnaround (≤ week) |
| Clear | Routine Turnaround |

The Project Manager will review all aspects of the documentation, specify any additional analytical requirements and resolve any remaining discrepancies before sample processing begins. After Project Manager final approval has been obtained (indicated by the Project Managers initials and the date on the Service Request and laboratory-specific parameter sheets), the master file will be returned to Log-In for preparation of laboratory job folders. A job folder will be created for each laboratory section involved in sample processing for a given project. Laboratory job folders are color-coded as follows:

| Job Folder Color | Designation |
|---|---|
| Red | Accelerated Turnaround (< 7 days) |
| Yellow | Accelerated Turnaround (7-14 days) |
| Orange | Organic Extractions (Routine TAT) |
| Blue | NWTPH-HCID Analyses |
| Neutral (manila) | >14 day TAT |
| Pink (or other) | Client Specific |

Copies of the Service Request and all pertinent laboratory-specific documentation required to accurately complete sample analysis will be placed in each laboratory job folder. Laboratory job folders will then be distributed to appropriate laboratory sections for analysis and incorporation into the section tracking system.

Subcontracting Policies

In some instances, ARI cannot perform certain analyses due to current laboratory workload limitations or specific analytical equipment requirements. In these instances it becomes necessary to subcontract work to other laboratories. In order to guarantee that data quality and defensibility are of the same high standards that ARI strives to achieve within our laboratory, policies regarding selection and use of subcontractor laboratories have been established as follows:

1. ARI's client must be made aware that samples will be subcontracted and what laboratory they will perform the analyses.
2. The sample information and analytical requirements are first entered into the ARI LIMS in the same way that samples for in-house analyses are processed. Subcontractor laboratories are contacted to verify their preparedness, and samples are then submitted to them using ARI chain-of-custody forms. These chain-of-custody documents are included in the master folder for the project.
3. Subcontractor laboratories must qualify to perform the analyses using the same criteria applied to ARI. When appropriate, subcontracted laboratories may be asked to submit documentation such as proof of certification or accreditation, quality assurance plans, standard operating procedures, results of method detection limit studies, control limits to ARI. ARI may at its discretion perform an on-site assessment of subcontracted laboratories. Failure to submit requested documents or refusal of an on-site assessment will disqualify laboratories from subcontracting ARI sample analyses.
4. ARI may request that subcontract laboratories analyze, on double blind performance testing (PT) sample obtained from commercial vendors at the subcontractor's expense.

5. The laboratory must be willing to maintain an annual contract with ARI, and must list ARI as a co-insured on the subcontract laboratory's liability insurance policies. Financial stability is also evaluated on a lab-by-lab basis.

### 6.4 Sample Custody

To ensure the traceability of sample possession, chain of custody is documented from sample collection to completion of final analysis, and is maintained during sample storage in archive prior to disposal. This is achieved through completion of a written chain of custody record. Custody of all samples and extracts processed by the laboratory is documented at each step of the analytical process.

The National Enforcement Investigations Center (NEIC) of EPA defines custody in the following ways:

*It is in your actual possession, or*
*It is in your view, after being in your physical possession, or*
*It was in your possession, then you locked or sealed it up to prevent tampering, or*
*It is in a secure area.*

Sample handling may vary and specific custody procedures have been developed for each laboratory section.

Custody at Sample Log-in

A Chain of Custody Record must accompany all samples received by the laboratory. This record documents all sampling activities as well as persons handling the samples prior to receipt by the laboratory. Sample receiving staff assumes custody of samples upon receipt from the client or courier. Samples will remain in the custody of Sample receiving until the samples are delivered to a laboratory section. Should samples require shipment to a subcontracting laboratory, a separate Chain of Custody Record will be completed to document the sample transfer. Chain of Custody records will be included with sample data reports in the final analytical package submitted to the client. Copies of these records will be filed with project data.

Custody of Volatile Organic Analysis (VOA) Samples

Upon completion of sample the sample receiving process, samples requiring analysis for volatile organic analysis will be placed in the VOA refrigerator (freezer) designated for incoming samples and logged into the VOA sample receipt logbook. The samples are now in the custody of the VOA laboratory. To avoid possible cross-contamination of low level samples, those samples known or suspected to contain high levels of contaminants, will be stored in a separate refrigerator prior to analysis.

VOA Laboratory analysts complete the receiving process and move the samples to a refrigerator designated for "active" samples. Samples removed from storage for analysis are considered to be in the custody of the analyst responsible for sample processing. All samples to be analyzed will be listed in the analytical logbook for the selected instrument. Laboratory and client sample identifications, the bottle number and Identification of the analyst performing the analysis will be indicated in the logbook. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from sample analysis, to further document sample custody.

After completion of sample analysis, soil and intact water sample containers will be placed in the refrigerator designated for sample archival. Any water sample remaining in the container after completion of analysis will be considered compromised and will be discarded. The samples will remain in archive and in the custody of the VOA laboratory until final disposal.

Custody of Semi-volatile Organic Analysis (SVOA) Samples

Upon completion of sample log-in, samples requiring extraction for organic parameters will be placed in walk-in cooler number 5. All samples placed in the cooler will be logged into the *Walk-in Admission Logbook*. Removal of samples from the refrigerator for processing by Extractions or Conventional personnel must be indicated in the *Walk-in Admission Logbook*. Samples stored in this walk-in refrigerator remain in Log-In custody until removed to a laboratory for processing.

The analyst responsible for the custody and initial handling of samples within the sample preparation laboratory will be indicated on the Sample Preparation Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Residual sample volumes will be archived in the refrigerator designated for extractable organic samples. Transfer of residual samples to this refrigerator will be documented in the *Sample Archive Refrigerator Logbook*. Transfer of prepared sample extracts to the appropriate analytical sections will be documented in the Extract Log in the preparation laboratory and in the Extract Log in the analytical section. Upon extract transfer, the analytical section receiving the extract assumes custody.

Extracts removed from storage for analysis are considered to be in the custody of the analyst responsible for analysis. Removal of extracts for analysis will be indicated in the Extract Log in the analytical section. All extracts to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory and client sample identifications, as well as the analyst performing the analysis will be indicated in the logbook. Analysts will initial raw data generated from extract analysis to further document sample custody. After completion of analysis, extracts will be placed in the refrigerator designated for archive. Extracts will remain in storage and in the custody of the analytical section until final disposal.

Custody of Inorganic and Metals Samples

Upon completion of the sample receiving process, samples requiring preparation or analysis for inorganic parameters will be placed in the designated walk-in cooler. Selected samples such as those requiring a critical analysis are placed directly in the laboratory. Removal of samples from the refrigerators for digestion and/or analysis will be indicated in the *Walk-in Admission Logbook* for the appropriate refrigerator. Samples stored in the walk-in refrigerators remain in Log-In custody until the laboratory removes the samples for processing.

The analyst responsible for custody and initial handling of samples within the metals preparation laboratory will be indicated on the Sample Digestion Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Transfer of completed sample digests to the metals instrument (analysis) laboratory will be

documented by the metals preparation laboratory. Upon transfer of digests, custody is considered to be the responsibility of the analytical section receiving the digests.

Digests removed from storage are considered to be in the custody of the responsible analyst. . All digests to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory sample identifications and the analyst performing the analysis will be indicated in the logbook. If it is necessary for digest custody to be transferred to another instrument or analyst, the second analyst records this information. Thus, custody of a given digest can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from digest and analysis to further document sample custody. After completion of analysis, digests will be stored by and remain in the custody of the analytical laboratory personnel until final disposal.

The analyst performing the sample analysis will remove samples requiring analysis for other inorganic (conventional) parameters from storage. Removal will be documented in the *Walk-in Admission Logbook*. Custody of the sample will be considered to be the responsibility of that analyst. All samples to be analyzed will be indicated on the worksheet for the required parameter. Laboratory sample identifications and the analyst performing the analysis will be indicated on the worksheet. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. The analysts' initials will be indicated on the worksheet to further document sample custody.

Special Chain of Custody Requirements

Should a client project require additional or more detailed custody documentation, requirements will be incorporated into the procedures for that project. Samples processed as part of the USEPA Contract Laboratory Program require more stringent chain of custody procedures. For this program, removal of samples and extracts for analysis (or any reason) will be documented in the Sample Control Log. Date, time and reason for removal, and date and time of return, will be fully documented. Removal of samples or extracts for permanent archiving or disposal will also be fully documented in the Sample Control Log.

### 6.5 Sample Archival and Disposal

After completion of analysis, unused sample aliquots are routinely stored for a specified period of time: 30 days for water samples and 60 days for soil samples. Colored markers are placed on samples with specific storage requirements during the sample receiving process. The color-coding is defined in the following table:

| Label Color | Storage Requirement |
|---|---|
| Red | Hold until further notice |
| Orange | Suspected Hazardous |
| Yellow | Shared Sample containers |
| Blue | Samples to be frozen |

Samples submitted for archival will be logged into the Sample Archive Logbook. Laboratory and client identifications, as well as archive date will be indicated in the logbook. The anticipated disposal date for the sample set will also be noted. The logbook will be reviewed several times during each week to determine samples scheduled for disposal. On or soon after the scheduled disposal date, the samples will be removed from archive storage and disposed.

In consideration of disposal requirements for hazardous samples, each sample processed by the laboratory will be evaluated for contamination levels based on final analytical results. Those samples containing analytes of interest at or above regulated disposal levels will be identified and handled as hazardous waste. A designated staff member coordinates periodic pickup and disposal of hazardous waste by an USEPA approved TSD (Treatment, Storage, and Disposal) Company and maintains hazardous waste disposal records. Specific guidelines for handling hazardous samples and waste are detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures)

# SECTION 7: PROJECT MANAGEMENT AND TRACKING

## 7.1 Project Management

Concise and accurate communication between a client and ARI, and within the laboratory, is an extremely important requirement for generating quality analytical results. All clients contracting with ARI will be assigned to a Project Manager. The Project Manager confirms that project requirements are consistent with laboratory capabilities, and coordinates with laboratory sections to provide analytical results within specified project timelines. Project organization, monitoring, and follow-up is the responsibility of Project Management staff.

Client project requirements and Project Managers' areas of expertise will be considered for client assignment. To ensure that all clients and projects receive the attention necessary for successful project completion, Project Manager workloads will also be considered. Project Managers will serve as the central focus for all project related activities and communications.

The Project Manager will review work plans and requirements for all pending projects. Any questions related to the work plan will be addressed prior to project commencement. The Project Manager will consult with appropriate analytical sections to clarify any issues regarding procedures and capabilities. Project deliverables requirements will also be addressed at this time. Upon receipt and log-in of project samples, the Project Manager will review all documentation to ensure that samples were properly logged in, and that analytical and QC requirements were correctly specified. The Project Manager will also provide any additional project related information that will assist the analytical sections with sample analysis. Laboratory sections will not process a sample until Project Manager approval has been given. Exceptions are parameters with critical (less than 48 hour) holding times or those that arrive on weekends or holidays when none of the Project Managers can be contacted.

Throughout the project, the Project Manager will monitor all analytical activities to help ensure that the project is completed and delivered on schedule. Any issues arising during sample processing will be promptly discussed with the client. Likewise, the analytical staff will be informed of any client concerns or project modifications. The Project Manager will also address any issues that arise during subsequent review of the analytical data by the client.

### 7.2 Project Tracking

Monitoring the laboratory workload ensures that adequate staffing and equipment will be available to produce quality analytical data and meet client needs. At the time a client project is tentatively scheduled, information regarding the project will be documented in the Project Management Database. Project particulars, sample quantities, parameters and anticipated sample delivery dates will be specified, as well as any prearranged analytical costs. Project work plans and any other project information will be kept on file with the Project Manager. Schedules for pending projects are communicated to the lab sections through periodic distribution of database printouts. Upon receipt of project samples, the project Inquiry number will be referenced to ensure project requirements are accurately specified. The original project documentation will be placed in the master folder as part of the project file.

Each laboratory section analyzing project samples will be responsible for ensuring that all analyses are accurately completed by the required date. All staff members are required to be aware of holding times, special analytical requirements, and required turnaround times. Analytical sections will remain in close communication with the Project Management staff so that any issues arising during sample analysis can be promptly addressed or discussed with the client.

Project Managers or their designee are responsible for monitoring project status. Sample status reports are generated as needed from LIMS and are distributed to lab sections and Project Managers. These reports allow the Project Managers to review project status and identify any samples which must be expedited to meet project timelines. Additionally, verbal communication between Project Managers and lab sections provides information about project status.

After sample analysis, report generation, and final review have been completed, data and final reports will be forwarded to the Project Manager. If requested, preliminary and interim results will be forwarded to the client. When all final data are available, the Project Manager will assemble the final package, verifying that all analyses were completed and project requirements met. A project narrative detailing the particulars of sample processing will be generated. After assembly and prior to shipment, the Project Manager will perform a final, cursory review of the package for any inconsistencies or incorrect information. The package

will then be forwarded to clerical personnel for photocopying and shipment. The Project Manager will determine final analytical costs and submit this information to the Accounting department for invoicing. Upon completion, all raw data and documentation associated with each client project will be compiled and stored as part of the laboratory project files. A chart detailing laboratory workflow as described in this section is included as Appendix G.

# SECTION 8: ANALYTICAL METHODS

To ensure that all data generated are consistent and comparable, clearly defined procedures will be followed for all aspects of sample processing, control and management. Standard Operating Procedures (SOPs) provide detailed guidelines for completing a procedure. Document control procedures and periodic audits will ensure that operations are performed in accordance with the most current SOPs. All routine deviations from published will be noted in the SOPs. Analysis specific deviation will be noted in Analyst Notes and in the Analytical Narrative.

## 8.1 Responsibilities

It is the responsibility of staff members to perform all procedures in accordance with the guidelines specified in the Standard Operating Procedures. Laboratory management is responsible for ensuring that SOPs are followed throughout the laboratory. The QAPM is responsible for coordinating periodic review and revision of existing SOPs and generation of additional SOPs. The QAPM is also responsible for maintaining SOP document control and ensuring that the most current versions of all SOPs are available to staff members.

## 8.2 Methods

Laboratory procedures may reference any established methods specified in the following publications:

*1. Code of Federal Regulations (Section 40)*
*2. Test Methods for Evaluating Solid Waste (USEPA SW-846)*
*3. USEPA Contract Laboratory Program Statement of Work for Organic Analysis*
*4. USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis*
*5. Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series)*
*6. Standard Methods for the Examination of Water and Wastewater*
*7. Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)*
*8. Navy Installation Restoration Laboratory Quality Assurance Guide(February 1996)*
*9. Hazardous Waste Remedial Actions Program (HAZWRAP)*
*10. State of Alaska Department of Environmental Conservation (ADEC)*
*11. Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods*
*12. Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)*
*13. The Department of Defense Quality Systems Manual (DoD-QSM)*
*14. Washington State Sediment Sampling and Analysis Plan*

The laboratory will adhere to established methods whenever possible. Occasionally, however, procedures determined to provide more accurate final results will be incorporated into the method. Should the laboratory procedures deviate from the established method, all modifications will be detailed in the associated SOP. A listing of laboratory SOPs is included as Appendix E.

### 8.3 Standard Operating Procedures

Standard Operating Procedures (SOPs) are detailed, step-by-step instructions for completing a laboratory operation. SOPs will address all procedures within the laboratory, from initial project identification to final data archival. SOPs will be generated for procedures developed within the laboratory and for those that follow established methods.

To ensure consistency in defining procedural guidelines, all SOPs will contain the following sections:

*Scope and Application*
*Definitions*
*Equipment*
*Documentation and Forms*
*In-house Modifications to Referenced Method*
*Procedures*
*Review*
*Quality Control*
*Corrective Actions*
*Miscellaneous Notes and Precautions*
*Method References*
*Appendices*

SOPs will be monitored through the laboratory document control system. Each SOP will be assigned a document control number as detailed in Section 5.2 of this LQAP. SOPs are revised whenever a laboratory procedure is changed or modified. All SOPs are reviewed and revised as necessary at least once a year. Personnel normally performing the procedure or analysis perform the review. SOPs will be generated for each new procedure implemented within the laboratory. Review, modification, new SOP generation, and distribution will be coordinated through the QAPM. The QAPM will periodically audit the laboratory sections to verify that the most current versions of all SOPs are in use. Document release will be controlled as detailed in section 5.2.

### 8.4 Method Selection and Use

Method selection will be based on availability of analytical instruments and equipment, chemical standards, expected method performance and marketability. Methods that are defined and accepted by regulatory agencies and familiar to ARI's clients are preferred. The Laboratory Manager and QAPM in consultation with marketing, client service, and laboratory supervisory staff are responsible for selecting appropriate methods. Client or project-specific methods may be used when appropriate.

The most recently promulgated method will be used for all procedures. Non-promulgated methods will be investigated if requested by a client. Section supervisors and managers are responsible for ensuring that the procedures in use reflect the requirements of the promulgated methods. Any modifications made to the method must be documented in the SOPs. Method modifications may be acceptable, provided all acceptance criteria specified in the method are met.

Section supervisors and managers review newly promulgated methods. SOPs will be modified as necessary to reflect the new methods. When possible, the annual SOP review will be coordinated with anticipated method promulgation dates. This is especially useful for large method compilations, such as SW-846. If the annual SOP review and method promulgation cannot be coordinated, SOPs will be revised as soon as possible after a method has been promulgated, especially when method changes are significant.

SOPs will be generated to reflect the most commonly used methods and protocols. If more than one method is used for an analysis, separate SOPs should be generated. Several methods may be incorporated into one SOP, provided that each method is clearly identified and defined in the SOP. Method modifications or special requirements for ongoing projects, or for specific programs (Navy, CLP, etc.), will be incorporated into the SOP. These requirements will be annotated to indicate that they are project/program specific. Analysts and technicians will be responsible for ensuring that, when required, project or program specific procedures are followed. SOPs will be controlled as specified in section 5.2.

## 8.5 Method Performance

Method performance must be demonstrated for all new methods prior to using methods for sample analysis. Section supervisors and managers are responsible for ensuring that method performance is demonstrated and support procedures have been performed.

Method performance will be demonstrated in the following manner:

A draft SOP will be generated for the method. The SOP must provide sufficient detail to perform the analysis and must accurately reflect the published method. Any steps in the method for which analyst discretion is allowed must be clearly defined.

A method detection limit (MDL) study must be performed for the method. Method detection limits must be verified to be at or lower than any method-specified detection limits. Method detection and reporting limits must be established.

Method precision and accuracy must be evaluated. This may be determined using an MDL or IDL study. Replicates will be evaluated for precision; analyte values will be compared to spike amounts to determine accuracy. Any method-specified precision and accuracy criteria must be met.

All method performance results will be reviewed and compiled by the section supervisor. Results will be filed with the QA section. A final SOP will be generated and distributed.

# SECTION 9: INSTRUMENT CONTROL

## 9.1 Detection Limits

To verify that reported limits are within instrument and method capabilities, three levels of detection have been established: instrument detection limits, method detection limits, and reporting limits. Instrument and method detection limits are statistically based values, determined from replicate analyses of analytical standards. Reporting limits are based upon the experience and judgment of an analyst. Reported values will be qualified based on the established limits. All limits will be summarized and controlled by the QAPM and are included as Appendix I.

Instrument Detection Limits

The instrument detection limit (IDL) is considered to be the smallest signal above background noise that an instrument can reliably detect. This limit reflects whether or not the observed signal has been caused by a real signal or is only a random fluctuation of noise from the blank. The IDL does not take into consideration the performance or efficiency of analytical methods.

Instrument detection limits are determined annually, or when ever a major change has been made, for each instrument in the metals analysis laboratory. Seven replicates, of a blank, or standards containing analytes at levels three to five times the expected IDLs are analyzed on three non-consecutive days. The IDL value for an analyte is three times the average of the standard deviations from the three replicate sets of analyses.

Method Detection Limits

The method detection limit (MDL) is considered to be the lowest concentration of an analyte that a method can detect with 99% confidence. Method detection limits will be established for all analytical parameters according to the guidelines specified in the Code of Federal Regulations, Section 40. Seven replicate samples are fortified with target analytes at levels that are one to five times (but not exceeding 10 times) the expected detection limits. The MDL for an analyte is determined to be the standard deviation of the replicates times the appropriate student's t-test value. More than seven replicates may be processed, but all replicates must

be used in the MDL determination. To report data without qualification, statistically determined MDLs cannot exceed any method specified MDLs.

Laboratory supervisors or managers review all statistically determined MDLs for accuracy and validity. The section supervisor or manager is responsible for ensuring that any unusable MDL studies are reprocessed. Once accepted, MDL study results and associated raw data will be forwarded to the QA section for further review and additional approval. MDLs approved by both section management and QA will be considered final and acceptable for use. Finalized MDL values are forwarded to Computer Services for incorporation into ARI's LIMS.

MDL studies will be conducted for all analyses performed by the laboratory on representative water, sediment and, tissue samples when appropriate and suitable sample matrices are available. MDL studies for inorganic analyses are only performed on aqueous samples. MDL studies will be performed on all instruments used for sample analysis. To allow for reevaluation of method performance, MDL studies will be performed on an annual basis. The QAPM is responsible for ensuring that all MDL studies are performed at least annually. Section supervisors and managers are responsible for determining if and when additional MDL studies should be performed due to changes in analytical methods, instrumentation or personnel.

## Reporting Limits

Reporting Limits (RL) are the lowest quantitative value routinely reported. Analytical results below the RL will be expressed as "less than" the reporting limit. RLs are estimated values based upon the MDLs, experience and judgment of the analyst, method efficiency, and analyte sensitivity. No reporting limit will be lower than its corresponding MDL. RLs will be verified on a regular basis either by having a calibration standard at the limit or by analyzing a standard at the RL immediately following initial calibration.

## Analytical Standards

Generation of high quality results is dependent upon the use of accurately prepared analytical standards. Many stock standards used within the laboratory are commercially prepared solutions with certified analyte concentrations. Neat standards used for stock standard

preparation are of the highest purity obtainable. Standard preparations are fully documented in appropriate logbooks.

Responsibilities

It is the responsibility of each laboratory employee involved with standards preparation to ensure that all standards are correctly and accurately prepared through the use of good laboratory practices and analytical verification. It is also the responsibility of these staff members to properly document the receipt and/or preparation of all standards. Management is responsible for ensuring that all staff members follow specified standards preparation and inventory procedures. The QAPM is responsible for periodically auditing standard preparation records to verify compliance with the laboratory Quality Assurance Program.

Organic Standards Preparation

Two types of standards are utilized for extractable organic compounds: neat standards from which stock solutions are prepared, and commercially prepared stock solutions from which working solutions are prepared. The type of standard depends upon availability. Commercially prepared standards are preferred when available.

Preparation of stock solutions will be documented in the Stock Solutions Log. To ensure traceability, commercially prepared stock solutions will also be documented in the Stock Standard Solutions Log. Each solution will be assigned a unique stock number determined by the page number and entry number on the page, preceded by “S” to indicate the solution is a stock, volatile stock standard are labeled “VS”. For example, the third entry on page 44 will be assigned the stock number S44-3. For stock solutions prepared from neat standards, the compound, supplier, lot number, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst should review the preparation information to verify accuracy. For commercially prepared stock solutions, the compound, supplier, lot number and expiration date will be recorded. As a stock solution is not actually prepared in-house for these commercial solutions, it is not necessary to record or verify a preparation schematic.

Preparation of working solutions (including spike and surrogate solutions) will be documented in the Working Standard Solutions Logbook. Each solution will be assigned a working

standard number determined by the page number and entry number on the page. For example, the second entry on page 73 will be assigned the working standard number 73-2. For volatile organic standards, the working standard number is preceded by "VW". The compound, stock solution reference, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst will review the preparation information to verify accuracy. After analyzing the standard and confirming that it is acceptable, analytical verification will be documented in the logbook.

Discarded or consumed standards will be annotated in the logbook by drawing a single line through the entry, indicating "discarded" or "consumed" above the line with confirming initial and date. Existing standard numbers will not be reused. Instead, each new stock or working solution made will be assigned a new number.

Standards preparation will be performed in accordance with good laboratory practices. Syringes, glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Neat standards that are less than 97% pure must be corrected for concentration. Standard solutions will be stored in amber bottles with Teflon-lined caps. Each standard solution will be labeled with the solution number, compound, analyst initials and expiration date. Stock solutions will be stored in the appropriate standards freezer; working solutions will be stored in the appropriate standards refrigerator.

Metals Standard Preparation

Commercially prepared single element stock solutions are used for all elements. Preparation of working solutions from these single element stocks will be documented in the Solutions Logbook. Preparation of check standards will also be documented in the Solutions Logbook. The element, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. Working calibration standards are prepared weekly for furnace and ICP analyses and as needed for ICP-MS. Calibration verification standards are prepared daily for GFA analyses and as needed for ICP and ICP-MS analyses.

Standards preparation will be performed in accordance with good laboratory practices. All preparation equipment will be thoroughly cleaned prior to and after use.

Inorganic (Wet Chemistry) Standard Preparation

Working standards for wet chemistry parameters will be prepared on a daily basis, prior to starting an analysis. Stock and check standard solutions will be replaced as solutions expire or are consumed. Stock and check standard solutions will be labeled with the compound, preparation data (weight and volume), units of concentration, preparation date, expiration date, and analyst initials.

Standards preparation will be performed in accordance with good laboratory practices. Glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Stock standards will be stored in containers appropriate for the parameter.

**9.3 Calibration**

Instrumentation and equipment used for sample processing and analysis must be operating optimally to ensure that accurate analytical results are generated. Verification of optimum operation is accomplished through various tuning and calibration procedures. Criteria for determining the accuracy of calibration are specified for all instrumentation and equipment. Prior to sample analysis, calibrations will be analyzed and evaluated against specified acceptance criteria. Acceptance criteria are either published as part of the method or generated at ARI using control charts. Calibration verifications will also be analyzed throughout an analytical sequence to ensure that instrument performance continues to meet acceptance criteria.

**Gas Chromatography/Mass Spectrometry (GC/MS)**

All GC/MS systems will be evaluated through analysis of an instrument performance check solution and calibration standards. The composition of the standards varies depending on the analysis performed on the system. System evaluation will be performed prior to sample analysis. Evaluation criteria used for GC/MS analyses are as specified for the SW846 methods.

> Instrument Performance Check Solution - Prior to analysis, the system will be evaluated to ensure that mass spectral ion abundance criteria are met. Bromofluorobenzene (BFB) is analyzed for volatile organic analyses and

Decafluorotriphenylphosphine (DFTPP) is analyzed for semi-volatile organic analyses. All ions must meet method-specified criteria.

The instrument performance check solution will be analyzed at a minimum of every 12 hours during the analytical sequence. Each analysis of the check solution will be verified against the specified criteria.

Calibration - After instrument performance has been verified, each GC/MS system will be calibrated to verify response linearity. For volatile organic analyses, up to eight standards ranging from 1 to 200 µg/L will be analyzed. For semi-volatile organic analyses, five to seven standards ranging from 2 to 80 µg/L will be analyz. The standard levels evaluated will vary depending on the compound. Initial calibration results will meet percent relative standard deviation acceptance criteria.

A continuing calibration verification standard at a mid-level concentration (routinely 50 µg/L for VOA and 250 µg/L for SVOA) will be analyzed at a minimum of every 12 hours during the analytical sequence. For continuing calibrations, minimum response factor and percent difference criteria will be considered in evaluating the acceptability of the calibration. Initial and continuing calibration acceptance criteria for volatile and semi-volatile organic analyses are presented in Appendix J. All calibration data printouts will include the following documentation:

*Date of calibration,*
*Identification of standard used*
*Identification of person performing the calibration*

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will also note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated. These results will be kept on file with the raw data in the Data Services section.

Internal Standard Responses - Internal standard responses and retention times in all standards will be evaluated immediately after analysis. This will serve as a baseline from which all sample internal standard responses and retention times will be evaluated.

Gas Chromatography (GC)

Each GC and HPLC system will be calibrated to verify response linearity. Depending on the parameter, five to seven standards at concentrations covering the linear range of the instrument will be analyzed. Percent relative standard deviations for initial calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

A continuing calibration standard at mid-range concentration will be analyzed after every 10 samples or more frequently if the method or conditions warrant. Percent differences between

initial and continuing calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

Calibration for organochlorine pesticides will follow SW-846 guidelines. The initial calibration sequence specifies the analysis of Resolution Check, Performance Evaluation, five-point initial calibration, individual standards and instrument blanks. Criteria for evaluating these standards are as follows:

> Performance Evaluation - The Performance Evaluation standard will be analyzed immediately following the Resolution Check standard. All standard peaks will be completely resolved. Individual breakdowns of DDT and Endrin will be less than or equal to 15% on both columns. A Performance Evaluation standard will also be analyzed at the end of the calibration sequence.
>
> Initial Calibration - An initial calibration consisting of levels of standard concentrations will be analyzed immediately following the analysis of aroclor 1660 curve and individual aroclor and Toxaphene standards. The percent relative standard deviation (RSD) will not exceed SW-846 guidelines or 20% on each column.
>
> Continuing Calibration - A midpoint Aroclor 1660 and or a midpoint pesticide standard along with a performance evaluation standard are analyzed after every ten (10) sample analyses. The continuing calibration standards will be within 85 - 115% of the initial calibration. The Performance Evaluation standard will meet previously specified criteria.

The analytical sequence may continue indefinitely, provided that calibration criteria are met throughout the sequence. Additionally, retention times for all compounds will fall within the retention time windows established by the initial calibration sequence of the three standard concentration levels.

All calibration data printouts will include the following documentation:

> *Date of calibration,*
> *Identification of standard used, and*
> *Identification of person performing the calibration.*

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated.

Metals

Analytical instrumentation for metals will be evaluated through the analysis of calibration standards, calibration blanks, and calibration verification standards. Initial calibrations will be performed prior to sample analysis.

**Inductively Coupled Plasma Atomic Emission Spectrometry (ICP)**

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards with a single concentration for each analytical wavelength. The calibration is immediately verified with the analysis of an initial calibration verification standard (ICV) obtained from a source independent from the IC standard. The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±2 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using standards of increasing concentrations. These standards are analyzed against the normal calibration curve and must be within 10% of their true value to verify linearity. At a minimum this upper range will be checked every six months or whenever major changes are made to the instrument. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

**Atomic Absorption Spectroscopy (Graphite Furnace and Cold Vapor)**

Atomic absorption instrumentation is initially calibrated using a minimum of three standards of varying concentrations and a calibration blank. Initial calibration is performed daily or more frequently if conditions warrant. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The initial calibration verification standard

value will be within ± 10% of the true value whereas the CCV will be considered in control if it is within ±10% for Graphite Furnace analysis or ±20% for Cold Vapor analysis.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected. Any sample determined to have a concentration above the high calibration standard will be diluted and reanalyzed.

**Inductively Coupled Plasma Mass Spectrometry (ICP-MS)**

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using high level standards. These standards are analyzed daily, or as necessary, against the normal calibration curve and must be within 10% of their true value to verify linearity. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

**Inorganic Analyses other than Metals (Conventional Analyses)**

Instrumentation and equipment used in analyzing samples for conventional wet chemical parameters (predominantly inorganic anions and aggregate organic characteristics) will be evaluated through the analysis of either internally prepared primary standards or externally derived Standard Reference Materials.

Depending upon the analysis, calibration is based upon direct stoichiometric relationships, regression analysis, or a combination of the two. Stoichiometry generally involves standardization of a titrant against a known primary standard and then the use of that titrant for determining the concentration of an unknown analyte (e.g. the use of sodium thiosulfate in the iodometric titration of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between analyte concentration and the response produced by the measurement being employed. Regression analysis is used for colorimetric determinations, ion specific electrode analysis and ion chromatography. The curve of response versus concentration is fit by the method of least squares using linear, polynomial or logarithmic regression dependant upon the pattern of response being measured.

Calibration is repeated for each analytical batch. Immediately following calibration, the standardized titrant or the calibration curve will be verified by the analysis of an Initial Calibration Verification standard (ICV) and Initial Calibration Verification Blank (ICB). The verification standard will be derived from a source other than that used for standardization or development of the standard curve. The ICV must return a value within 10% of its known concentration. The ICB must be less than the Reporting Limit (RL) or the lowest point on the standard curve, whichever is less. Initial calibration verification must be successfully completed prior to the analysis of any samples.

Calibration verification will be repeated after every ten samples processed during an analytical run. This Continuing Calibration Verification (CCV) will validate the method performance through an analytical sequence. If the continuing calibration values for either the standard or blank are out-of-control, the analyst will verify the outlying condition and, if verified, the analysis will stop and the method will be re-calibrated. All samples run between the outlying CCV and the preceding in-control CCV will be re-analyzed. In-control verification standards and blanks must bracket all samples within an analytical run.

Initial calibration depending upon the analysis is based on either a direct stoichiometric relationship, a linear regression analysis or a combination of the two. Stoichiometry generally involves standardization of a titrant and use of that titrant for determining the concentration of an unknown analyte (e.g. the use of thiosulfate in iodometric determination of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between the analyte concentration and the response produced by the measurement being employed. The curve is fit by the method of least squares using a linear, polynomial or logarithmic regression depending on the response being measured. The regression coefficient will be greater than or equal to 0.995 for the calibration to be considered acceptable.

Initial calibration curve is verified throughout the analytical sequence by analyzing a calibration verification standard after every 10 sample analyses. The calibration verification standard value will be within ± 10% of the initial calibration.

After initial calibration, a calibration blank will be analyzed to determine target analyte concentration levels. The level of analyte detected in the calibration blank will be less than the lowest standard concentration in the initial calibration.

# SECTION 10: DATA VALIDATION and REVIEW

One hundred percent (100%) of laboratory data generated at ARI are subjected to a four level validation (review) process prior to release from the laboratory. The four levels of review are:

1. Analyst review
2. Peer review
3. Supervisory review
4. Administrative review

The data review process is outlined below and detailed in SOPs 200S through 206S.

In addition, Quality Assurance Personnel review 10% or more of all completed data packages for technical accuracy, project compliance and completeness. The data validation outlined below is completed in addition to the initial project review explained in Section 7 and QA specific reviews outlined in Section 11. If it is determined at any point during the analysis, reporting, or review process that data are unacceptable, prompt and appropriate corrective action must be taken. The corrective action will be determined by the situation. It is the responsibility of all staff members involved in data reporting and review to be aware of the quality control requirements and to be able to identify occurrences that require corrective action.

**Analyst review:**

Each analyst is responsible for producing quality data that meets ARI's established requirements for precision and accuracy and is consistent with a client's expectation.

Prior to sample preparation or analysis an analyst will verify that:

1. Sample holding time has not expired.
2. The condition of the sample or extract is described accurately on the laboratory bench sheet.

3. Specified methods of analysis are appropriate and will meet project required Data Quality Objectives.
4. Equipment and Instrumentation are in proper operating condition.
5. Instrument calibration and/or calibration verification are in control.

During sample preparation or analysis an analyst will:

1. Verify that Method Blanks and Laboratory Control Samples are in control.
2. Verify that QC (replicate, matrix spike analyses, SRM, etc.) samples meet precision and accuracy requirements.
3. In addition to verifying that quality control requirements are met, the analyst will review each sample to determine if any compound of interest is present at levels above the calibrated range of the instrument.
5. Check for data translation or transcription errors
6. Record all details of the analysis in the appropriate bench sheet or logbook.
7. Note any unusual circumstances encountered.

Following the analysis or sample preparation an analyst will:

1. Examine each sample and blank to identify possible false positive or false negative results.
2. Determine whether any sample requires reanalysis due to unacceptable quality control.
3. Review data for any unusual observances that may compromise the quality of the data, such as matrix interference
4. Review and verify that data entry and calculations are accurate and no transcription errors have occurred.
5. Document anomalous results or other analytical concerns on the bench sheet, corrective action form or Analyst Notes for incorporation into the case narrative.
6. Note data with qualifying flags as necessary.

7. Enter reviewed data into LIMS as appropriate, incorporate all necessary sample and quality control information into the data package and forward it for further review.

**Peer review:**

A second analyst trained in the appropriate SOPs will complete a peer review. Peer review will include at a minimum:

1. Verification that all QA (holding times, calibrations, method blanks, LCS, spiked sample analyses, etc.) criteria are in control.
2. Examination the data for possible calculation and transcription errors.
3. Review bench sheets and analyst notes for completeness and clarity.
4. Approve the analytical results or recommend corrective action to the laboratory supervisor.

When a second trained analyst is not available a peer review is not completed.

**Supervisory Review:**

Following analyst and peer review the data is forwarded to the laboratory section supervisor for review. The supervisor will:

1. Review the data package for completeness and clarity.
2. Follow-up on the peer review recommendations.

Designated reviewers normally perform the peer and supervisory reviews for GC-MS data. The reviewers are identified on the organizational chart in Appendix A.

**Administrative Review:**

The results of all analyses are reviewed for compliance with quality control criteria and technical correctness before data is released to the Project Manager for distribution to clients. Designated reviewers in the Metals, Conventional and Organic laboratories perform administrative reviews. Personnel responsible for administrative reviews are noted in the Organizational Chart in Appendix A to this LQAP.

Administrative review is the final data validation process. Personnel performing the administrative review are responsible for the final sign-off and release of the data. Following administrative review the data is released to Project Managers for incorporation into the final data deliverable package.

Administrative review will:

1. Verify that the analytical package submitted for reporting is complete and contains all necessary information and documentation.
2. Verify that appropriate and necessary data qualifying flags (Listed in Appendix N) have been used.
3. Verify that method blank and LCS data are acceptable, quality control requirements were met for surrogates in all samples and blanks, and that all necessary re-analyses or dilutions were performed.
4. Check the technical validity (i.e. are total metal > dissolved metals, is the cation/anion balance correct, etc.) of the complete data set.
5. Verify that all necessary final data reports have been generated and that all necessary data and documentation are included in the package.
6. Approve data reports for release.

## 10.2 Quality Assurance Review

10% (1 out each 10) final data packages are reviewed by ARI's QA staff for compliance with ARI's QA Program. This assessment includes, but is not limited to, review of the following areas:

1. Reporting and analysis requirements
2. Initial and continuing calibration records
3. Quality control sample results (method blank, LCS, spikes, replicates, reference materials)
4. Internal and surrogate standard results
5. Detection and reporting limits
6. Analyte identifications.

Data review activities are summarized and documented by the reviewer. The review notes are filed with the associated raw data in the project file. Any QA-related deficiencies identified during the data review will be forwarded to the QAPM for corrective action.

# SECTION 11: QUALITY CONTROL SAMPLE ANALYSIS AND EVALUATION

Routine analysis of quality control (QC) samples is necessary to validate the quality of data produced in the laboratory. ARI routinely analyses the following quality control samples: method blank (MB), holding blank (HB), laboratory control sample (LCS), matrix spike (MS) and sample replicate (MD or MSD). Section 11.3 defines these QC samples. The number and type of QC analyses depend on the analytical method and/or the QA/QC protocol required for the analyses. An expected result has been defined for each type of QC analysis. If quality control sample results meet all specified criteria, the analysis is considered to be "in-control" and the data acceptable. Conversely, quality control sample results that do not meet the specified criteria indicate that the procedure may not be generating acceptable data and corrective action may be necessary to bring the process "in-control".

In addition to QC analyses, ARI routinely uses surrogate standards to measure the efficiency of all analyses targeting organic analytes.

Detailed information concerning sample preparation batches, QC analyses and surrogate standards follow:

## 11.1 Sample Preparation Batch

All QC samples will be associated with a discrete sample preparation batch. A preparation batch is defined as 20 or fewer field samples of similar matrix processed together by the same analysts, at the same time, following the same method and using the same lot of reagents. Additional batch requirements are detailed in ARI's method specific standard operating procedures. Each preparation batch will be uniquely identified. All samples, field and QC, will be assigned an ARI LIMS ID number and will be linked to their respective preparation batch. Each sample batch will contain all required QC samples in addition to a maximum of twenty field samples.

ARI will accommodate client, QC protocol or QAPP specific sample batching schemes.

## 11.2 QC Sample Requirements

Each preparation batch will include, at a minimum, a method blank (MB) and a laboratory control sample (LCS). Additional QC samples will be analyzed based upon the specific QC protocol required, data deliverable requirements or client request. ARI recommends that QC samples used to measure analytical precision also be included in each sample batch. These may include: a matrix spike and a matrix spike duplicate pair; a sample duplicate and a matrix spike pair or an LCS duplicate (LCSD) for comparison with the LCS.

## 11.3 QC Sample Definitions

### 11.3.1 Method Blank (MB)

A method blank is an aliquot of water or solid sample matrix that is free of target analytes and is processed as part of a sample batch. The MB is used to verify that contaminants or compounds of interest have not been introduced into samples during laboratory processing. MBs will be spiked with surrogate standards for all organic analyses.

ARI defines an acceptable MB as one that contains no target analytes at a concentration greater than one-half ARI's reporting limit or 5% of an appropriate regulatory limit or 10% of the analyte concentration in the sample which ever is greatest.

A minimum of one method blank will be included in each preparation batch. A maximum of twenty samples may be associated with one method blank. An acceptable MB is required prior to analysis of field samples from a preparation batch. For methods not requiring pre-analysis sample preparation, a minimum of one method blank will be analyzed immediately prior to sample analysis, periodically throughout the analytical sequence, and also at the end of the sequence.

The results of the MB analysis will be reported with the sample results.

### 11.3.2 Holding Blank (HB)

Holding blanks are organic-free water samples that are placed in each volatile organic sample storage refrigerator to monitor for possible cross-contamination of samples within the storage units. A holding blank from each refrigerator will be analyzed every 14 days. Holding Blank

analyses will be reviewed by laboratory management and archived in ARI's electronic document archive.

### 11.3.3 Laboratory Control Sample (LCS)

An LCS is processed as part of each preparation batch, and is used to determine method efficiency. An LCS is an aliquot of water or solid matrix free of target analytes to which selected target analytes are added in known quantities. The analytes spiked into LCS samples are listed in ARI's method specific SOPs. LCS will be spiked with surrogate standards for all organic analyses.

Following analysis the percent recovery of each added analyte is calculated and compared to historical control limits. Current control limits are listed in Appendix K of this document. When calculated recovery values for all spiked analytes are within specified limits, the analytical process is considered to be in control. Any recovery value not within specified limits requires corrective action prior to analysis of any field samples from the associated preparation batch.

A minimum of one LCS will be prepared for each sample preparation batch. LCS analysis for those methods not requiring pre-analysis sample preparation will be performed after each continuing calibration. The results of all LCS performed will be reported with the sample results. A maximum of twenty samples may be associated with one LCS.

Specific clients or QA protocol may require the analysis of a duplicate LCS. When LCS duplicates are analyzed the failure of any analyte in either LCS to meet QC limits must trigger a corrective action.

### 11.3.4 Replicate Analysis

Replicate analyses are often used to determine method precision. Replicates are two or more identical analyses performed on subsamples of the same field sample at the same time. Replicate analyses should be performed on samples that are expected to contain measurable concentrations of target analytes.

The calculated percent difference between replicates must be within specified limits or corrective actions are required. Percent differences exceeding the specified limit signal the

need for procedure evaluation unless the excessive difference between the replicate samples is clearly matrix related.

For inorganic analyses, a minimum of one replicate set should be processed for each analytical batch. Replicate sample analyses are not routinely performed for organic parameters. Instead, analytical precision is evaluated through the analysis of a duplicate matrix spike sample (MSD).

In order to perform replicate analyses, ARI's must receive sufficient volume to prepare the replicate aliquots.

Field replicates submitted to the laboratory will be analyzed as discrete samples.

### 11.3.5 Matrix Spike

A matrix spike is an environmental sample to which known quantities of selected target analytes have been added. The matrix spike is processed as part of an analytical batch and is used to measure the efficiency and accuracy of the analytical process for a particular sample matrix. The analytes spiked into MS samples are listed in ARI's method specific SOPs. MS samples will be spiked with surrogate standards for all organic analyses.

Following MS analysis the percent recovery of each spiked analyte is calculated and compared to historical control limits. If recovery values for the spiked compounds fall within specified limits, the analytical process is considered to be in control. When calculated recovery is outside of historical limits corrective action is recommended.

Matrix spike duplicate (MSD) analyses are often used to measure method precision and accuracy. In this case the relative percent difference for recovery of spiked compounds is calculated and compared to established criteria.

Unless directed otherwise, ARI's policy is to prepare a matrix spike and a duplicate with each batch of samples for inorganic analysis and an MS/MSD set for each batch of samples for organic analyses. Analyte recovery and RPD values are reported with sample data.

### 11.3.6 Standardized Reference Material (SRM)

An SRM is material analyzed and certified by an outside organization to contain known quantities of selected target analytes independent of analytical method. SRMs are normally purchased from outside suppliers outside of ARI and are supplied with acceptance criteria. Analysis of SRM is used to assess the overall accuracy of ARI's analytical process. SRM are routinely analyzed with each batch of samples for wet chemistry (conventionals analysis) samples. External reference samples are analyzed after instrument calibration and prior to sample analysis. Compound recovery values not within the specified limit signal the need to evaluate either the calibration standards or instrumentation.

### 11.3.7 Other Quality Indicators

In addition to analyzing the quality control samples outlined previously, various indicators are added to environmental samples to measure the efficiency and accuracy of ARI's analytical process. Surrogate standards are added to extractable organic samples prior to extraction to monitor extraction efficiency. Surrogate standards will also be added to volatile organic samples prior to analysis to monitor purging efficiency. Internal standards are added to metals digestates for ICP-MS analyses and to organic samples or extracts prior to analysis to verify instrument operation.

The calculated recovery of surrogate analytes is compared to historical control limits to aid in assessing analytical efficiency for a given sample matrix.

## 11.4 Control Limits

To provide a means for evaluating whether or not a process is in control, acceptance limits have been established. These are based on internal, historical data for organic analyses and method specified limits for inorganic analyses. Samples associated with a specific program or contract (such as the USEPA Contract Laboratory Program) will be evaluated against program/contract-specified criteria. Routine samples will be evaluated against internally generated control limits. Project specific control limits will be used as required provided they have been reviewed for feasibility and approved by laboratory management.

Results of QA analyses are transferred from the LIMS to a control limit and chart generation program. The QAPM coordinates control chart and control limit generation. Control limits will

be generated for LCS compound recoveries, surrogate recoveries, and matrix spike compound recoveries, on a method and matrix specific basis. Advisory control limits will be utilized for analyses performed on an infrequent basis until a sufficient number of usable data points are collected. Control limits are updated at least annually, but may be updated more frequently if method or instrument changes have been made. Laboratory control and acceptance limits are detailed in Appendix K.

Two levels of control limits are utilized in evaluating process control: warning limits and action limits. Limits are statistically determined from values obtained from LCSs or other control samples. Warning limits, within which 95% of all results are expected, equal ± two standard deviations from the average result. Action limits, within which 99.7% of all results are expected, are equal to ± three standard deviations from the average result. Mean values, warning limits, and action limits are necessary for thorough evaluation of process control.

### 11.5 Control Charts

Control charts, in conjunction with other control sample analyses, are useful in verifying that an analytical procedure is performing as expected. The control chart provides a pictorial representation of how closely control sample results approximate expected values, as well as showing analytical trends. Indicated on the control chart are the mean and upper and lower warning and action limits. The warning and action limits are used to determine whether or not an analytical process is in control. The mean is used to determine whether results obtained for a procedure are trending upward or downward, which may ultimately affect the accuracy of sample results.

The QA Officer will coordinate generation of control charts based on laboratory data at least semi-annually. These control charts will be distributed to and reviewed by section supervisors and managers. Any significant trends or variations in results will be identified, and the source of the trend corrected. Copies of control charts will remain on file in the QA section. At the bench/instrument level, individual results from quality control samples are evaluated against the limits.

# SECTION 12: CORRECTIVE ACTIONS AND REESTABLISHMENT OF CONTROL

To produce quality data, it is important that all aspects of the analytical process are under control and that all specified quality control criteria are met. On occasion, however, procedures, reagents, standards, and instrumentation can fail to meet specified criteria. Should any of those situations occur, the quality of data produced may be compromised. When procedures no longer appear to be in control, sample processing will be halted and appropriate actions will be taken to identify and rectify any instrument malfunctions or process-related issues. Prior to resuming sample analysis, verification of control will be made through the analysis of various control samples. Actions taken and observations made during reestablishment of control will be fully documented on the bench sheet or as an Analyst Note. Only when control has been regained and all actions documented will sample processing resume. This ensures that no results generated during the suspect period will be reported.

## 12.1 Responsibilities

It is the responsibility of all laboratory personnel involved with sample processing to be able to determine whether or not a procedure is in control and to verify that all data are produced under conditions that are “in control”. It is at the analytical level that unacceptable conditions are most easily detected and addressed. These personnel are also responsible for employing and documenting all necessary corrective actions taken to regain control of a procedure. Samples processed during suspect periods will be reprocessed, and suspect data will be appropriately annotated to indicate that it is of questionable quality. The analytical staff will verify that all data submitted for review has been generated under acceptable conditions. All anomalies will be documented on the Analyst Notes form and will include such information as: type and source of anomaly, reasons for the anomaly, and actions taken to correct the problem. All personnel involved with subsequent and final data review are responsible for verifying that data were generated under acceptable conditions. If suspect data are identified at the review level, responsible analysts should be contacted to determine whether additional actions (such as reanalysis) will be taken. In addition, reviewers will confirm that anomalies

noted by the analyst were indeed addressed and that appropriate corrective actions were taken.

On occasion, it is not possible to generate data that meet all Quality Control Standards. This may be due to sample volume limitations or sample matrix effects. It is the responsibility of the analytical and data review staff to document these situations and to maintain communication with the Project Management staff. The Project Management staff, in turn, is responsible for notifying the client or specifying additional actions to be taken. Project Managers are further responsible for ensuring that clients fully understand which data are questionable and the reasons why acceptable results could not be generated.

It is the responsibility of the QAPM to perform regular reviews of corrective action procedures to ensure that unacceptable conditions or suspect data will be identified prior to releasing results. Section managers and supervisors are responsible for ensuring that appropriate corrective action procedures are in place and that all staff members are trained to identify and act upon “out of control” situations.

### 12.2 Corrective Actions

There are various stages of the analytical process where the procedure may fall out of control and require corrective action. In general, all procedures and equipment will be monitored to verify that control is maintained during sample processing. The following details those stages as well as the actions taken to reestablish and verify control.

Sample Preparation

During sample preparation, all glassware associated with a specific sample will be clearly labeled to eliminate the possibility of sample mix-up or mislabeling. Laboratory staff will ensure that sample-identifying labels are accurately completed and that correct sample identification is maintained at all times. If a sample appears to have been misidentified or mixed with another sample during preparation, the suspect samples will be discarded and new aliquots taken. If there is insufficient sample for a second preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Addition of surrogate standards or matrix spiking solutions will be carefully monitored to ensure that all samples are accurately fortified. Volumes and standard solution numbers of all

standards added to samples will be recorded on the bench sheet. If there is suspicion that a sample has been incorrectly spiked a new sample aliquot should be prepared. If there is insufficient volume for re-preparation, the bench sheet will be annotated to indicate which samples may be inaccurately fortified.

If sample matrix hinders processing per standard procedures, the section supervisor or manager will be consulted for guidance on appropriate actions. Preparation of smaller sample aliquots or employment of different procedures may be necessary. Any deviations from normal protocols will be documented on the bench sheet.

If at any time during sample preparation sample integrity is compromised or a procedural error is noted, the sample will be discarded and re-prepared. If insufficient sample volume is available for re-preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Calibration and Tuning

Prior to sample analysis, all instrumentation will be calibrated and tuned to ensure that equipment meets all criteria necessary for production of quality data. Equipment must meet the calibration criteria specified in the section entitled “Calibrations”, per manufacturer specifications or per project/contract requirements. If these criteria are not met, corrective actions must be employed. Any corrective actions taken will be fully documented in the appropriate logbook, indicating the problem, the actions taken, and verification. Samples will not be analyzed until initial verification of system performance has been made. In the event that continuing calibration results do not meet criteria, sample analysis will not resume until corrective actions have been employed or the system has been re-calibrated.

GC/MS Analyses - Analysis of the instrument performance check solution (BFB or DFTPP) will meet the specified ion abundance criteria. Initial calibration standards at a minimum of five concentrations will meet specified response factor and percent relative standard deviation criteria. It criteria are not met for initial calibration, the system will be inspected for malfunction. The initial tuning and calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed at a minimum of once every 12 hours. All response factor criteria will be met. Additionally, the percent difference between the initial and continuing calibrations will meet specified criteria. If criteria

are not met, the system will be inspected for malfunction. The initial tuning and calibration verification will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

Internal standard responses and retention times for standards will meet specified criteria. Any sample not meeting internal standard criteria will be reanalyzed. If reanalysis yields the same response and the instrument is determined to be functioning correctly, the failure to meet criteria will be attributed to sample matrix interference. No further re-analyses will be required.

GC Analyses - Organochlorine pesticide calibrations will be evaluated using either USEPA CLP or SW-846 guidelines. The Resolution Check standard will meet resolution criteria and Endrin and DDT breakdown in the Performance Evaluation standard will meet breakdown criteria. Initial calibrations will meet percent relative standard deviation criteria. If, during the initial calibration sequence, criteria are not met, the system will be inspected for malfunction and the initial calibration be reanalyzed. Samples will not be analyzed until all initial calibration criteria are met.

Continuing calibrations of either the mid-level calibration standard or Performance Evaluation standard will be analyzed every 12 hours. If continuing calibration criteria are not met, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples previously analyzed between the acceptable and unacceptable continuing calibration will be reanalyzed.

If, during the analytical sequence, retention time shifting occurs, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples with retention times outside the specified windows will be reanalyzed.

For all other analyses, initial calibration standards analyzed at a minimum of five concentrations will meet percent relative standard deviation criteria. If criteria are not met for initial calibration, the system will be inspected for malfunction. The calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed after every 10 samples. All percent differences between the initial and continuing calibrations will meet specified criteria. If criteria are not met, the system will be inspected for malfunction and re-calibration will be performed. Samples analyzed between an acceptable and unacceptable calibration check will be reanalyzed.

Metals and Inorganic Analyses - Initial calibrations will be verified by analyzing a calibration check standard immediately after calibration. The percent differences between the initial calibration and calibration check standard will meet specified percent difference criteria. If criteria are not met, the system will be inspected for

malfunction. The initial calibration and calibration check will be reanalyzed until acceptance criteria are met.

The calibration check standard analyzed after every 10 samples will meet percent difference criteria. If the calibration check standard is not acceptable, the system will be inspected for malfunction and re-calibration will be performed as necessary. Samples analyzed between acceptable and unacceptable calibration check standards will be reanalyzed.

Instrument Blanks

Prior to sample analysis, instrument and/or calibration blanks may be evaluated for the presence of target analytes. If analytes are detected, the concentrations must be below the reporting limits for those analytes. If analytes are detected at levels above the reporting limits, the source of contamination will be identified. Sample analysis will not commence until analyte levels in instrument and calibration blanks are below the reporting limits. Instrument and calibration blanks are analyzed for VOA analysis only if sample carryover is suspected.

Instrument and calibration blanks will also be analyzed throughout the analytical sequence. These will not contain target analytes at levels above the method detection limits for organic parameters or the reporting limit for inorganic parameters. If one or more analytes exceed the RL, an additional blank will be analyzed. If analyte levels are still above the method detection limits, the system will be inspected for malfunctions and the source of contamination will be identified. Sample analysis will not resume until instrument and calibration blank analyte levels are below the RL. Organic samples analyzed between acceptable and unacceptable blanks will be evaluated to determine the need for reanalysis per the following guidelines:

If no target analytes are detected in the samples, reanalysis will not be required.

If sample target analyte levels are above the method detection limits, samples will be reanalyzed at analyst discretion. Reanalysis will be dependent upon the analyte levels and whether or not there is likelihood that analytes detected are a direct result of system contamination.

If the analytes present at unacceptable levels in the instrument blank are not of interest or concern in the associated samples, reanalysis will not be required. This is often a consideration for ICP analyses where analytes of concern may be only a subset of the possible analytes.

Methods for the analysis of inorganic analytes require that all samples associated with an out of control blank be re-analyzed.

Method Blanks

Prior to sample analysis, method blanks will be evaluated for the presence of target analytes. Ideally, no target analytes should be present in the method blank. If analytes are detected at or above the Reporting Limit, the method blank will be reanalyzed to verify that the contamination is not a result of instrument carryover or malfunction. If the presence of target analytes is confirmed, the concentrations must be below the RL for those analytes.

Several volatile and semi-volatile compounds and certain elements are considered to be common laboratory contaminants. Concentrations of these common laboratory contaminants may exceed the method detection limits, but may not be present at concentrations greater than five times the method reporting limits. Target analytes considered to be common laboratory contaminants are:

**Volatile Organic Compounds**

*Methylene Chloride*
*Acetone*
*2-Butanone*

*Semi-volatile Compounds*
*Dimethylphthalate*
*Diethylphthalate*
*Di-n-butylphthalate*
*Butylbenzylphthalate*
*bis-(2-Ethylhexyl) phthalate*
*Di-n-octylphthalate*

If target analyte concentrations in the method blank exceed the acceptable levels and instrument malfunction or contamination has been ruled out, the method blank and all associated samples will be re-prepared and reanalyzed. If there is insufficient sample volume remaining for reprocessing, the Project Manager will be notified. If it is necessary to report results associated with an unacceptable method blank, the results will be qualified to indicate possible laboratory contamination.

In the event that an analyte detected in the samples ≥ 20 times the method blank levels re-preparation and reanalysis is not required. It is assumed that any contamination in the method blank is insignificant and will not affect final quantified results.

Laboratory Control Samples

Prior to sample analysis, the laboratory control sample (LCS) will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If LCS recoveries are out of control, corrective action is required. Corrective actions may include anything from a written explanation in the case narrative up to re-preparation and reanalysis of the entire sample batch.

Internal Standards

For volatile and semi-volatile organic analyses, internal standard results will be evaluated after each analytical run to verify that the values are within acceptance limits. Internal standard values will be within -50% to +100% of the internal standard values in the continuing calibration. If any internal standard does not meet the criteria, the system will be evaluated to confirm that all instrumentation is operating properly. The sample will then be reanalyzed. If the reanalysis results do not meet acceptance criteria, it will be assumed that the sample matrix is affecting internal standard values. Further reanalysis will not be required.

Surrogate

Surrogate recovery values will be evaluated after each analytical run to verify that the values are within acceptance limits. If recovery values are outside acceptance limits, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of surrogate spike solutions added are accurate. For extractable organic analysis, bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system documentation, solution preparation or spiking errors are identified, the following considerations will be made:

When a volatile organic surrogate recovery value is outside of acceptable limits, the sample will be reanalyzed. If the reanalysis results are within acceptance limits, it will be assumed that the initial analysis was in error. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery. Further reanalysis will not be required.

For semi-volatile organic analysis, one acid and one base/neutral surrogate recovery may be outside acceptance limits with no corrective action required provided the recoveries are at least 10%. If more than one acid or base surrogate standard is outside acceptance limits, or if any surrogate recovery value is less than 10%, the sample will be re-extracted and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery assuming all other QC analyses are acceptable. Further reanalysis will not be required. *Matrix spikes will not be re-extracted for unacceptable surrogate recovery values.*

For other extractable organic analysis, if a surrogate recovery value is outside of acceptance limits, the data will be reviewed to determine if the unacceptable surrogate is a result of matrix effect. If matrix interference is determined, the sample will be re-extracted or if re-extraction is not deemed useful, fully documented in the analytical narrative associated with the analyses. If a surrogate recovery is too low, based on the opinion of the final QA Data Reviewer, the sample will be re-extracted and reanalyzed.

Matrix Spikes

Matrix spikes will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If unacceptable results are obtained, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

Organic Analyses:

If a matrix spike recovery value is outside the acceptance limits, but the LCS meets recovery acceptance criteria, re-extraction will not be required. It will be assumed that the unacceptable recovery value is a result of matrix effect.

If both LCS and matrix spike recovery values are outside the acceptance limits, the sample batch will be re-extracted and reanalyzed. This indicates the possibility of a systematic error that may affect the accuracy of final results.

Inorganic analyses:

Matrix spikes with unacceptable recovery values will be re-prepared and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that the sample matrix is affecting the recovery values. Further reanalysis will not be required.

A post-digestion spike analysis will be performed for all metals analyses processed following EPA-CLP guidelines.

Sample and Matrix Spike Replicates

Sample and matrix spike replicates will be evaluated to verify that percent differences between the replicates are within acceptable limits. Percent differences for metals and inorganic sample replicates will be within ±20%. When percent difference criteria are not met, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

If percent difference values between sample replicates for metals and inorganic analyses do not meet acceptance criteria the Project Manager in consultation with ARI's client will determine weather to re-analyze the samples or flag the analytical results. If the samples are reanalyzed and results are not within acceptance limits, it will be assumed that the sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Replicate sample analyses are not routinely performed for organic parameters.

If percent difference values between matrix spike replicates do not meet acceptance criteria, but spike recovery values are acceptable, no re-extraction or analysis will be required. It will be assumed that the sample is not homogeneous, causing the poor analytical precision.

If percent difference values between matrix spike replicates do not meet acceptance criteria and recovery values in one or both replicates are not acceptable, the sample and associated matrix spike replicates will be re-prepared and reanalyzed. If the

reanalysis results are not within acceptance limits, it will be assumed that the sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Samples

In addition to monitoring sample quality control indicators, samples will be evaluated to determine the need for reanalysis. The following conditions will be considered while evaluating samples:

If a target analyte detected in a sample exceeds the upper limit of the instrument calibration range, the sample will be diluted and reanalyzed. Dilution and reanalysis will be performed until the analyte concentration falls within the linear range of calibration. If the sample requires dilution to such a level that surrogates are no longer detectable and analytical accuracy is questionable, the sample will be re-prepared using a smaller sample aliquot.

Samples will be evaluated for matrix interference that may affect analyte detection and quantification. Appropriate cleanup procedures will be employed to remove interference. Samples will be diluted and reanalyzed as required to minimize background interference. If it is not possible to remove all interference, reported results will be qualified as necessary.

If low-level analytes detected in a sample are suspected to be a result of instrument carryover, the sample will be reanalyzed. If analyte levels remain approximately the same the initial results will be considered valid. If analytes are not detected during reanalysis, it will be assumed that the initial detection was due to carryover, and the initial results will not be reported.

If an instrument malfunction or procedural error occurs during analysis, all affected samples will be reanalyzed. If the malfunction appears to be an isolated incident, it will not be necessary to inspect the analytical system. If the malfunction appears to be an ongoing problem, the system will be inspected and necessary maintenance/corrective actions will be taken prior to resuming analysis.

Sample Storage Temperatures

Every sample storage unit's temperature will be evaluated at the beginning of each day. Temperatures will be between 2 and 6 °C for refrigerators and < -10 °C for freezers. If a temperature is outside the specified range, the unit's temperature will be adjusted to bring the temperature back within limits. The Temperature Log will be annotated to document the adjustment.

If adjustment does not bring the temperature within range, or if adjustment is not possible, the Laboratory Supervisor will be notified and will take corrective action. The Temperature Log will

be annotated to document the action. If the temperature fluctuation is chronic or extreme, the samples will be removed from the unit and placed in another storage unit until the malfunctioning unit is repaired or replaced.

Balance Calibrations

Balances are serviced once a year by a certified technician. The service includes preventative maintenance and calibration.

Balance accuracy will be verified prior to balance use. The recorded weight will be within the acceptance criteria specified on the Calibration Log. If the recorded weight is not within the acceptance limits, the QAPM will be notified. The Calibration Log will be annotated to document the action. The balance will not be used until it can be verified that acceptance criteria can be met.

Water Supply System

The water supply for the volatile organic and inorganic laboratories will be monitored daily for the presence of contaminants through the analysis of method and/or instrument blanks. Organic contaminants, especially chloroform, are early indicators of the need for preventative maintenance. If organic or other contaminants are detected, the system filters will be changed. After filters have been changed, an additional aliquot of water will be analyzed to confirm that contaminants are no longer present.

The water supply for the metals laboratory will be monitored daily. When the resistivity falls below 18 megaohm, system maintenance will be performed.

# Section 13: LABORATORY EVALUATION AND AUDITS

Routine evaluations of the laboratory ensure that all necessary quality control activities have been implemented and are being effectively utilized. It is the responsibility of the QAPM to ensure that quality control activities are periodically evaluated for compliance. Findings from these evaluations allow the laboratory to address and modify any procedures that are not in accordance with the laboratory Quality Assurance Program or accreditation program requirements.

A number of tools are available for monitoring laboratory performance. ARI evaluates the quality of laboratory performance through the use of

*Internal QA Audits*
*Technical System Audits*
*Data Quality Reviews*
*Audits by Outside Agencies (External Audits)*
*Performance Evaluation Analyses*

Each audit provides an objective evaluation of laboratory performance. All internal audits and reviews are conducted according to specified guidelines. In addition, a collective review of audit findings provides an overall evaluation of the laboratory. Deficiencies noted during the course of an audit or performance evaluation will be addressed, a root cause analysis performed, and appropriate corrective actions will be taken. Follow-up audits will be conducted to verify that corrective actions have been satisfactorily implemented.

Internal QA Audits

The Quality Assurance Officer regularly evaluates quality control activities within the laboratory to verify accuracy and compliance. The QAPM or designee routinely audits the following activities:

*Balance verification records*
*Sample storage cooler temperature records*
*Oven, incubator and water bath temperature records*
*Chain of Custody records*
*Standard preparation records*

Checklists are utilized to ensure consistent and complete audits. The checklists are included in SOP 1005S. Internal QA audit results will be summarized and reported to both staff and management. Corrective actions will be initiated as necessary. A schedule of internal QA audits is provided in Appendix L.

Technical System Audits

An audit of technical systems within the laboratory will be conducted at least annually. The audit will focus on the quality control and data generation/collection systems. The QAPM will conduct the audit with assistance from section managers and data reviewers. This evaluation will address areas such as:

*Calibration records*
*Maintenance records*
*Control charts*
*Computer vs. hard copy data*
*Adherence to SOPs and methods*
*Support system records (DI water, balances, pipettes, etc.)*

In addition, audit results from the past year will be reviewed to verify that all necessary corrective actions have been addressed and implemented.

Audits by Outside Agencies (External Audits)

As a requirement for many accreditation programs, on-site review of laboratory facilities and operations are conducted by clients or other outside agencies. The laboratory may be periodically audited by the following agencies:

USEPA Contract Laboratory Program
State of Washington Department of Ecology
State of Washington Department of Health
US Naval Facilities Engineering Service Center (NFESC) (formerly known as NEESA)
Hazardous Waste Remedial Actions Program (HAZWRAP)
US Army Corps. of Engineers

External audits are beneficial in that they provide an independent evaluation of the laboratory without internal influence or bias. The laboratory will be available for evaluation

at the convenience of the auditing agency. Laboratory personnel will be available during the audit to address questions or provide information regarding laboratory procedures. All comments, deficiencies, and areas of potential improvement noted by the auditor will be reviewed, and appropriate corrective actions will be taken to resolve the noted issues. A listing of laboratory accreditations is included as Appendix M.

Performance Evaluations

Performance Evaluation (PE) sample analysis is a means of evaluating individual performance as well as the overall analytical system. In addition to the external audit, PE sample (PES) analysis is a requirement of many certification and accreditation programs. The laboratory routinely participates in the following performance evaluation programs:

*Analytical Standards, Inc.(ASI) Performance Evaluation Studies*
*USEPA Water Pollution (WP) Performance Evaluation Studies (Commercial Supplier)*
*USEPA Water Supply (WS) Performance Evaluation Studies (Commercial Supplier)*
*USEPA Contract Laboratory Program Quarterly Performance Evaluations (as required)*

A PES is a sample containing specific analytes in concentrations unknown to analysts. Comparison of the laboratory result to the "true" value determines the accuracy of the reported result and indicates the laboratory's ability to perform a given analysis. These results are also used to verify individual analyst proficiency. The QAPM will periodically submit internal “blind” performance evaluation samples to the laboratory sections for analysis. Values obtained by the laboratory will be compared to expected or true values. Parameters with reported values outside of the specified acceptable ranges will be evaluated by the analytical staff to determine the source of error. All necessary corrective actions will then be documented and implemented.

Quality Assurance Reports to Management and Staff

In order to ensure that laboratory managers are kept apprised of quality related activities and laboratory performance, a “Quality Assurance Report to Management” the QAPM will

be produced annually and distributed to ARI management. The report will, at a minimum include:

1. Information concerning current and ongoing internal and external audits
2. Status and results of current or ongoing internal or external proficiency analyses
3. Identification of Quality Control problems in the laboratory
4. Information on all ongoing Corrective Actions
5. Current status of external certifications
6. Current status of the Staff Training Program
7. Outline of new and/or future Quality Assurance Program initiatives

The QAPM is responsible for follow-up and resolution of any deficiencies discussed in the report. Unresolved issues will remain on subsequent reports until addressed. Information such as performance evaluation results and audit reports will be distributed to the laboratory staff.

The application of these combined activities provides comprehensive monitoring and assessment of laboratory performance, and ensures that all data produced by ARI will be of the highest possible quality.

# Section 14: APPENDICES

**A. Laboratory Organization and Key Personnel Resumes**
**B. Training and Demonstration of Proficiency**
**C. Laboratory Facilities**
**D. Laboratory Instrumentation**
**E. Standard Operating Procedures**
**F. Sample Collection Containers and Preservatives**
**G. Laboratory Workflow**
**H. Analytical Methods**
**I. Method Detection Limits and Reporting Limits**
**J. Tuning and Calibration Criteria, Volatile and Semi-volatile Organics**
**K. Quality Control Recovery Limits**
**L. Internal Audit Schedule**
**M. Laboratory Certification and Accreditation**
**N. Data Reporting Qualifiers**
**O. Personal Conduct Statement**
**P. QA Policies**
**Q. Modification to ARI's LQAP**

# Appendix A

# Laboratory Organization Chart
# and
# Key Personnel Resumes

# KEY PERSONNEL RESUMES

## Mark Weidner

Laboratory Director

Profile

Mr. Weidner co-founded Analytical Resources, Inc., along with Brian Bebee, Sue Dunnihoo and David Mitchell. Prior to his co-founding of ARI in 1985, Mr. Weidner was the Head Mass Spectroscopist at Michigan State University and an instructor at the Finnigan Institute. As Laboratory Director, Mr. Weidner is responsible for overall laboratory performance, as well as facility expansion and major purchasing. Mr. Weidner is intimately familiar with all operational and analytical aspects of ARI and initiated many of the procedures currently in use.

Education:

M.S., Medicinal Chemistry, Purdue University, W. Lafayette, IN (1978).

B.S., Biochemistry, Michigan State University, E. Lansing, MI (1975).

Experience:

Laboratory Director/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to present).

Senior Chemist, City of Seattle, Seattle, WA (1981 to 1985).

Instructor, Finnigan Institute, Cincinnati, OH (1979 to 1981).

Mass Spectroscopist, Michigan State University (1978 to 1979).

**Brian Bebee**

Laboratory Manager

Administrative Services Manager

Profile:

Mr. Bebee co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and David Mitchell. Prior to his co-founding of ARI, Mr. Bebee had gained extensive GC/MS experience as a GC/MS Chemist at the Municipality of Metropolitan Seattle, (METRO). When he co-founded ARI in 1985, Mr. Bebee became the Organics Division Manager until 1993, when he assumed the position of Laboratory Manager. As Laboratory Manager, Mr. Bebee is responsible for the day to day flow of all laboratory operations, including personnel, instrument, and procedural concerns. He is also responsible for the direct supervision of the Volatile and Semivolatile Laboratories.

Education:

A.A., Oceanography, Marine Biology, Biology, Shoreline Community College (1973).

Experience:

Laboratory Manager, Analytical Resources, Inc., Seattle, WA (1987 to present).

Organics Division Manager/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to 1987).

GC/MS/DS Operator, Municipality of Metropolitan Seattle, Seattle, WA (1980 to 1985).

Senior Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1976 to 1980).

Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1973 to 1976)

## David Mitchell

Quality Assurance Program Manager

Profile:

Mr. Mitchell co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and Brian Bebee. Prior to his co-founding of ARI, Mr. Mitchell had gained extensive experience in the environmental chemistry field as Senior Chemist and Trace Organics Laboratory Supervisor at the Municipality of Metropolitan Seattle (METRO). His responsibilities include the management of ARI's Quality Assurance/Quality Control Program.

Education:

Graduate Work in Chemistry (Organic/Biological), University of Wyoming, Laramie, WY (1970 to 1974).

B.S., Chemistry, Upper Iowa College, Fayette, IA (1970).

Experience:

Quality Assurance Manager, Analytical Resources Inc., Seattle, WA (1998 to Present)
Client Services Manager, Analytical resources Inc., Seattle WA (1987 to 1998)
Vice President/Co-founder of Analytical Resources, Inc., Seattle, WA (1985 to 1987).
Senior Chemist, METRO Trace Organics Laboratory, Seattle, WA (1979 to 1985).
Research Associate, Northwestern University Medical School (1974 to 1979).

## Susan Dunnihoo

Computer Services Manager
Administrative Services Manager

Profile:

Ms. Dunnihoo co-founded Analytical Resources, Inc., along with Mark Weidner, Brian Bebee, and David Mitchell. Prior to her co-founding of ARI, Ms. Dunnihoo had gained extensive experience in the environmental chemistry field through her work at Laucks Testing Laboratories, the City of Tacoma, and the Municipality of Metropolitan Seattle (METRO). As Computer Services Manager, Ms. Dunnihoo is responsible for the supervision of the Computer Services Section. She is also responsible for LIMS administration, which includes testing the LIMS for data integrity, as well as ensuring that client deliverable requirements are met.

Education

Graduate work in Chemistry, University of Washington.

B.A., Chemistry, Augsburg College, Minneapolis, MN (1976)

Experience

Computer Services Manager/Secretary, Analytical Resources, Inc., Seattle, WA (1985 to present)

Chemist, Laucks Testing Laboratories, Seattle, WA (1983 to 1985)

Chemist, City of Tacoma, Plant II, Tacoma, WA (1982 to 1983)

GC/MS/DS Operator, METRO TPSS Lab, Seattle, WA (1980 to 1982)

## Jay Kuhn

Inorganic Division Manager

Profile:

Mr. Kuhn oversees ARI's Inorganic Division, which includes the Metals Sample Preparation, Metals Analysis, and Conventional Wet Chemistry sections. He has extensive experience in the environmental chemistry field, with an emphasis in inorganic analyses. Mr. Kuhn is experienced with in-house and EPA standard methods and protocols, as well as the operation, maintenance, and repair of ICP-MS, ICAP, CVAA, and Graphite Furnace instruments.

Education

Graduate work in Environmental Chemistry, University of Washington, Seattle, WA.

B.S. Chemistry, University of California at Santa Barbara (1980)

Experience

Inorganic Division Manager, Analytical Resources, Inc., Seattle, WA (1992 to present)

Metals Division Manager, Analytical Resources, Inc., Seattle, WA (1990 to 1992)

Research Technologist III and Laboratory Manager, UW College of Forest Resources Chemical Analysis Cost Center (1985-1990)

Research Technologist, UW College of Forest Resources Chemical Analysis Cost Center (1981 to 1985)

# Appendix B

# Training

Qualification Requirements

In addition to on-the-job training, ARI recommends a specific level of education and experience for the following positions:

*GC/MS Laboratory Supervisor*

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC/MS systems and one year supervisory experience.

*GC Laboratory Supervisor*

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC systems and one year supervisory experience.

*Sample Preparation Laboratory Supervisor*

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience in organic sample preparation and one year supervisory experience.

*Data Systems/LIMS Manager*

A Bachelor's degree with four or more computer-related courses and three years experience in systems management or programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

*Programmer Analyst*

A Bachelor's degree with four or more computer-related courses and two years experience in systems or application programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

*Quality Assurance Officer*

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

*Project Manager*

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

*GC/MS Chemist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC/MS system. Three years of GC/MS operations and spectral interpretation experience may be substituted in lieu of educational requirements.

*Mass Spectral Interpretation Specialist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and participation in training course(s) in mass spectral interpretation. Also, at least two years of experience in mass spectral interpretation is recommended.

*Purge and Trap Expert*

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year experience operating a purge and trap type liquid concentrator interfaced to a GC/MS system.

*GC Chemist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and maintenance experience may be substituted in lieu of educational requirements.

*Pesticide Analysis Expert*

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and spectral interpretation experience may be substituted in lieu of educational requirements.

*ICP Spectroscopist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and Four years of applied experience with ICP analysis of environmental samples. Four years of ICP experience may be substituted in lieu of educational requirements.

*ICP Operator*

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining ICP instrumentation. Three years of ICP experience may be substituted in lieu of educational requirements.

*Atomic Absorption (AA) Operator*

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining graphite furnace and cold vapor AA instrumentation. Three years of AA experience may be substituted in lieu of educational requirements.

*Conventionals (Classical Chemistry) Analyst*

A Bachelor's degree in chemistry of a scientific/engineering discipline and one year of experience with classical chemistry procedures. Three years of classical chemistry experience may be substituted in lieu of educational requirements.

*Sample Preparation Expert*

A high school diploma and one college level course in chemistry. One year of experience in sample preparation is also recommended.

# Appendix C

# Laboratory Facilities

ANALYTICAL RESOURCES INC. occupies a total of 23,500 square feet of floor space located at 4611 S. 134th Place in Tukwila, Washington. The laboratory facility, constructed between September 2001 and June 2002, includes:

- State-of-the-art heating, ventilation and air conditioning (HVAC) systems to assure a clean comfortable working environment while maintaining air flow balance designed to minimize the possibility of sample cross contamination between laboratory areas.
- A central service area provides space for three walk-in coolers (356 sq. ft. total), two walk-in freezers (760 cubic ft.), eight reach-in freezers, and sample cooler storage.
- A data network linking all workstations to a centralized server room. All connections are made to managed switches and hubs and are protected by the latest firewall technology and uninterruptible power supplies.
- Distribution systems to deliver pressurized Air, Zero Grade Air, Argon, Helium, Hydrogen, Nitrogen and Argon/Hydrogen to the laboratory areas from a central location.
- A system to deliver ASTM Type 1 water directly to sinks in each laboratory area. Water is purified by filtration, ion exchange and reverse osmosis and continuously re-circulated through a filtration + ion exchange + UV radiation polishing loop that delivers water directly to the laboratories.
- An isolated and ventilated hazardous waste storage area.
- An electronic repair shop and storage room.
- Alarm monitored fire sprinkler and intrusion detection systems

The facilities are divided into five functionally-distinct sections as detailed below:

1) The Organics Division features three main laboratory areas as described below:
   - The Organics Extraction Laboratory (2400 sq. ft.) is utilized to isolate and concentrate organic compounds from various environmental sample matrices. The laboratory contains approximately 200 linear feet of bench space and nine fume hoods. It is equipped with two gel permeation chromatographs, an accelerated solvent extractor (ASE) and a gas chromatograph for extract screening purposes. The laboratory includes a separate area for extraction of aqueous samples, a glassware cleaning area and individual workstations for the laboratory supervisor and analyst.
   - The Semivolatile Organics Analysis Laboratory (3000 sq. ft) has 124 linear feet of instrument bench space plus personal workstations. The Laboratory is equipped with seven Gas Chromatographs (GCs) with six GC-MS instruments, one High Performance Liquid Chromatograph (HPLC) and a fume hood for preparation of standard solutions and dilution of samples. Each gas chromatograph is individually vented to the outside for removal of heat and potentially contaminated GC exhaust gases.
   - The Volatile Organics Analysis (VOA) Laboratory (2500 sq. ft) houses seven GC-MS and two GC-PID instruments dedicated to volatile organics analysis. Each instrument is vented to the outside. The laboratory area includes two fume hoods, a sample/standards preparation area, a TCLP preparation/tumbler room and sample holding refrigerators. The HVAC system maintains a positive air pressure in the laboratory using filtered air from outside of the building. This eliminates the possibility of cross contamination of samples with solvents from other areas of the laboratory.

2) The Inorganic Division includes a Trace Metals Laboratory and the Conventional Analyses Laboratory:

- Trace Metals Laboratory (3000 square feet)
    - The Metals Preparation Laboratory (1200 sq. ft) contains five fume hoods including two 8-foot polypropylene. An additional eight foot polypropylene laminar flow fume hood is housed in a separate class 1000 clean room. The lab is equipped with tumblers, hot-plates, digestion blocks, facilities for glassware cleaning, and a spectrophotometer for cold vapor analysis of mercury, a TCLP tumbler room, and storage areas.
    - The Metals Instrument Laboratory (1300 sq. ft) features two atomic absorption spectrometers for graphite furnace analyses, two inductively coupled argon plasma spectrometers (ICP) for simultaneous analysis of metals species, and an ICP-mass spectrometer for analysis of metals species at low detection levels.
    - A 500 sq. ft. Office provides desk area for Trace Metals laboratory personnel.
- The Conventional Analyses (Wet Chemistry) Laboratory (2500 sq. ft.) contains approximately 200 linear feet of bench space, eight fume hoods and includes a separate microbiology room. Instruments in this lab include two Rapid-Flow Analyzers, two TOC analyzers, an ion chromatograph, two uv/visible spectrophotometers, and various other equipment necessary for the evaluation of inorganic parameters.

3) The Geotechnical Laboratory includes 2500 square feet of space with special areas and equipment for soil testing, treatability studies, and soil/sediment leaching studies. The Laboratory includes approximately 50 feet of linear bench space and 5 fume hoods.

4) The Sample Receiving Facility consists of an area to accept and log-in samples to ARI's Laboratory Information Management System (LIMS) and an area to prepare and ship sampling supplies.
- The Sample Receiving Facility (1000 sq. ft.) is equipped with two fume hoods, and 70 feet of bench space. Four computer terminals are available to log samples into ARI's LIMS.
- The Sampling Containers Facility (500 sq. ft.) is used to prepare sampling containers for shipment to ARI's client designated locations.

4) Administrative Areas (8600 sq. ft.) include:
- The Quality Assurance Section
- Executive Offices
- Project Management Section
- The Human Resources Section
- The Computer Services Section
- Two Conference Rooms
- A Lunch Room
- Several Storage Areas

# Appendix D

# Instrumentation and Computers

# INSTRUMENTATION and COMPUTER SYSTEMS

## Organic Extractions Equipment

**(ASE 1) Accelerated Solvent Extractor (1998) –** Dionex ASE 200

**(GPC 1) Gel Permeation Chromatograph (1985) –** Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

**(GPC 2) Gel Permeation Chromatograph (2003) –** Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

## Gas Chromatograph - Mass Spectrometers (GC/MS)

**(FINN I) Finnigan MAT Incos 50 (1993) –** A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 5890 GC, a Tekmar LSC 2000 Purge and Trap and a Delta Perspective PTA-30 autosampler for VOA analysis of either aqueous or solid samples.

**(FINN III) Finnigan MAT Incos 50 (1987) -** A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes a Varian 3400 GC, a Tekmar LSC 2000 Purge & Trap and a Delta perspective PTA-30 autosampler for VOA analysis of aqueous samples.

**(FINN V) Finnigan MAT Incos 50 (1989) -** A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 5890 GC, a Tekmar LSC 2000 Purge & Trap and a Delta Perspective PTA-30 autosampler for VOA analysis of either aqueous or solid samples.

**(NT I) Hewlett Packard (1994)** - A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes a Hewlett Packard 5890 Series II Plus GC, an HP 5972A MSD and a HP 7673 autosampler.

**(NT 2) Hewlett Packard (1999)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 6890 GC, an HP 5973 MSD, an HP 7683 autosampler and an APEX Prosep 800 large volume injector.

**(NT3) Hewlett Packard (1999)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 6890 Plus GC, an HP 5973 MSD, a Tekmar LSC 2000 Purge/Trap and a Dynatech Precision Sampling PTA 30 autosampler for VOA analysis of aqueous or solid samples.

## Gas Chromatograph - Mass Spectrometers (GC/MS) (continued)

**(NT4) Hewlett Packard (2001)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an HP 6890-Plus GC, an HP 5973 MSD, an HP 6890 autosampler and an APEX Prosep 800 large volume injector.

**(NT5) Hewlett Packard (2002)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Tekmar LCS 2000 Purge and Trap and a Dynatech PTA 30 autosampler for VOA analysis of aqueous or solid samples.

**(NT6) Hewlett Packard (2002)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an HP 6890 Plus GC, an HP 5973 MSD and an HP 7683 autosampler.

## Gas Chromatographs

**Hewlett Packard 5890 Series II (2003) –** A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and integrator. Used for screening samples before full extraction.

**(ECD 1) Hewlett Packard 5890 (1986) -** A GC system equipped with dual ECD detectors, two capillary injectors, a HP 7673A autosampler and ChromPerfect data system.

**(ECD 2) Hewlett Packard 5890 Series II (2003) –** A GC system equipped with dual ECD detectors, two Cool on column capillary injectors, an HP7673A autosampler and ChromPerfect data system.

**(ECD 3) Hewlett Packard 5890 Series II (1991)** – A GC system equipped with Dual ECD detectors, two Cool on column capillary injectors, an HP7673 autosampler and ChromPerfect data system.

**(ECD 4) Hewlett Packard 5890 Series II (1994)** – A GC system equipped with dual ECD detectors, a split/splitless capillary injector, HP7673 autosampler and ChromPerfect data system.

**(FID 2) Hewlett Packard 5890 (1987)** – A GC system equipped with an FID detector, acapillary injector, an HP 7673A autosampler and ChromPerfect data system.

**(FID 3 A, B) Hewlett Packard 6890 (1996)** – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP Chemstation data system. A Restek GC Racer has been added to enhanced performance.

**(FID 4 A, B) Hewlett Packard 6890 (1996)** – A GC system equipped with dual FID detectors, two capillary injectors, a single tower HP 6890 autosampler, and HP Chemstation data system. A Restek GC Racer has been added to enhanced performance.

**(PID 1) Hewlett Packard 5890 (1988) –** A GC system equipped FID and PID detectors in series, an Dynatech PT30 autosampler and Tekmar LCS 2000 Sample Concentrator with ChromPerfect data system.

**(PID 2) Hewlett Packard 5890 – (1991)** –A GC system equipped with dual PID detectors, one in series with an FID, a Dynatech PT30 autosampler, an OI Analytical 4560 sample concentrator and a ChromPerfect data system.

**(ECD 5) Hewlett Packard 6890 Plus Micro – (2002)** – A GC system equipped with dual ECD detectors, two capillary column injectors, a dual tower HP 7683 autosampler, an APEX Prosep 800 large volume injector and an HP Chemstation data system.

**(FID 5) Hewlett Packard 5890 Series II (2005)** – A GC system equipped with FID and TCD detectors, an HP 7694 Headspace Sampler and HP Chem Station data aquisition system.

## Inorganic Instrumentation

**Perkin-Elmer SCIEX ELAN 6000 ICP-MS (1996)** - A completely automated ICP-Mass Spectrometer with autosampler and multitasking software. Computer controlled using ELAN NT Windows based software.

**Perkin-Elmer Optima 4300 ICP (2001)** - A completely automated dual view simultaneous ICP with auto-sampler and multitasking software.

**Varian 300Z (1992)** - A single channel atomic absorption graphite furnace instrument equipped with Zeeman background correction, and an auto-sampler.

**Varian 300Z (1991)** - A single channel atomic absorption graphite furnace instrument with Zeeman background correction, equipped with an auto-sampler.

**CETAC M-6000A Mercury Analyzer (2000) –** A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler.

**Dionex Ion Chromatography DX 500 (1997)** - Fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Peaknet software.

**Thermo Genesys 10 (2003)** - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

**Milton Roy 401 (1991)** - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

## Inorganic Instrumentation (continued)

**Alpkem RFA/2 Autoanalyzer (1990)** – The system is automated and computer controlled using Alpkem Soft Pac data acquisition for nutrient analysis.

**Lachat QuickChem 8000 Flow Injection Analyzer (2003)** – Automated flow injection instrument dedicated to low level nutrient analysis

**Dohrmann Apollo 9000 (2001)** - Total Organic Carbon (TOC) Analyzer. Includes an autosampler for water analysis

**Dohrmann DC190 TOC Analyzer with Boat Sampler (1994)** – Combustion/IR system dedicated to soil and sediment TOC analysis.

**Kontes Midi-Vap Cyanide Distillation Systems (1995)** – Each of the two systems is capable of simultaneously distilling up to 10 samples for cyanide analysis using small sample aliquots.

**Centrifuge (1987) -** Beckman Model GP with swinging bucket rotor and inserts for 250 ml bottles and scintillation vials

**Labconco 25 Place Block Digestion Unit.**

**Environmental Express Hot Block digestion blocks (8 ea) (1999-2002)** for digestion of samples prior to trace metals analysis.

**Hach COD Digestion Blocks (2)**

**Hach Ratio Nephelometer**

**Incubators: Lab-Line Ambi Hi-Lo Chamber** and **Thermolyne 41900.**

## GeoTech Laboratory Equipment

**Trautwein Soil Equipment 12 position flexible wall permeability station,**

**Soil Test Load frame, with 500, 2,000 and 10,000 pound load cells for QU, UU, and CU triaxial tests, with pore pressure.**

**Consolidation apparatus, 16 tsf**

**Geocon direct shear apparatus**

**Biosciences BI-1000, 8 position electrolytic respirometer**

**Microtox photo-luminescence toxicity tester**

**Beckman JP-21 refrigerated centrifuge with 6 x 500 ml fixed angle head**

**IEC DRP-6000 refrigerated centrifuge with a 4 x 1,000 ml swinging bucket head**

**Plas-Labs anaerobic test chambers**

**U.S. Army Corps of Engineers column settling; column and batch leaching apparatus**

## Network Servers

ARI's central laboratory computer is a Dell PC Server running the Windows NT platform. This system is home to ARI's Laboratory Information Management System (LIMS) database developed by Northwest Analytical of Portland, OR. The LIMS receives electronic data from all lab sections and produces hardcopy and electronic deliverables. In addition, the LIMS stores sample demographic data while providing a common tracking mechanism for all laboratory information.

The LIMS is connected to two sub-networks. Data is transferred electronically from the instrument data systems to the LIMS database. This key process enhances data integrity by reducing manual entry and manipulation of instrument output.

The metals section uses an Intel PC Server with the Windows 2000 Server operating system. This system runs as a file server for dBASE IV and MS Access 97 database applications. Once data is collected by the metals instrument computers, dBASE is used to process the data and transfer it to the LIMS database. The MS Access software has been customized by ARI's metals data supervisor to generate metals CLP forms and other internal reports.

The organics section uses an HP Unix Server with HP-UX 10.20 operating system. This system runs Target 3.4 data analysis software. All GC/MS and other GC instruments are networked to this system. In addition to providing one common platform for organics data processing, the Target software produces CLP forms for organics data packages.

The conventional analysis laboratory uses PC Workstations with MS Excel for data reduction. Data is manually entered into the LIMS systems using customized work lists.

Instrument data systems have been optimized with the latest software enhancements to reduce data processing time. Advances in processing have allowed ARI to meet the increasingly shorter turnaround requirements of our clients.

**Note: Extensive in-house replacement parts are available for lab instruments and computers, including spare circuit boards. A majority of all service maintenance is performed by ARI employees.**

# Appendix E

# ARI Active SOPs

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| | | **Sample Receiving / Project Management** | | |
| 001S | CSSR | Sample Receiving | 019 | 7/13/05 |
| 003S | CSSR | Project Tracking | 006 | 10/23/04 |
| 004S | CSPM | Data Storage, Archival and Retrieval | 007 | 2/20/06 |
| 005S | CSPM | Project Management | 004 | 10/30/04 |
| 056S | CSPM | Handling of USDA Regulated Soil | 001 | 10/12/05 |
| | | **Computer Services** | | |
| 101S | CO | Software Quality Assurance (Draft) | 003 | 2/25/04 |
| | | **Data Reporting** | | |
| 201S | DS | GC-Data Reporting and Review | 006 | 10/25/04 |
| 202S | DS | GC-MS Data Reporting and Review | 004 | 10/25/04 |
| 203S | DS | Volatile Organics Data Reporting and Review | 004 | 10/26/04 |
| 204S | DS | GC BETX Data Reporting and Review | 004 | 10/26/04 |
| 205S | DS | Conventionals Data Review and Reporting | 003 | 2/20/06 |
| | | **Organic Extractions** | | |
| 300S | E | Sonicator Function Testing | 007 | 10/14/05 |
| 301S | E | Organics Glassware Preparation | 008 | 10/29/04 |
| 302S | E | Silica Gel Clean-up for Pesticides and PCB | 002 | 4/24/06 |
| 303S | E | Tissue Extraction – Pesticide/PCB | 001 | 8/4/05 |
| 304S | E | Soil Extraction – NWTPH-D, AK102, AK103 MicroTip Sonication | 012 | 9/23/05 |
| 305S | E | BAN Extraction – Water – Separatory Funnel | 013 | 11/01/04 |
| 306S | E | Gel Permeation Chromatography | 003 | 10/28/04 |
| 308S | E | Water Extraction – NWTPH-D, AK102, AK103 | 013 | 5/17/05 |
| 311S | E | Pesticide/PCB Extraction – Water – Sep Funnel | 016 | 2/9/05 |
| 315S | E | Butyl Tin Extraction – Soil/Sediment – Sonication | 008 | 10/28/04 |
| 316S | E | Butyl Tin Extraction – Pore Water – Separatory Funnel | 011 | 3/8/03 |
| 320S | E | Butyl Tin Species – Sediment – *in-situ* Ethylation | 001 | 5/14/04 |
| 324S | E | Herbicide Extraction – Water – Separatory Funnel | 011 | 9/17/03 |
| 325S | E | Herbicides Extraction – Soil – Macro-tip | 009 | 10/10/05 |
| 326S | E | Extraction of Water for Organophosphorus Pesticides | 007 | 8/27/00 |
| 327S | E | Extraction of Soil for Organophosphorus Pesticides | 006 | 10/18/99 |
| 328S | E | Chlorinated Phenols – Water – Separatory Funnel | 011 | 10/25/04 |
| 332S | E | PCB Extraction – Wipe Samples | 008 | 3/8/03 |
| 333S | E | PCB Extraction – Soil - Medium Level | 009 | 6/6/05 |
| 334S | E | Sulfur Removal from Sample Extracts | 006 | 2/9/05 |
| 335S | E | Sulfuric Acid Clean-up of Sample Extracts | 009 | 2/9/05 |
| 336S | E | Low Level Manchester Extraction for Pesticides and PCBs | 014 | 1/31/05 |
| 340S | E | BAN Extraction – Tissue – Tissuemizer | 009 | 7/28/05 |
| 341S | E | SIM-PNA Extraction – Water – Liquid Liquid | 003 | 9/17/03 |

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| 342S | E | Extraction of Soil Samples for NWTPH-HCID | 009 | 3/9/05 |
| 344S | E | BAN Extraction – Water – Liquid-Liquid | 011 | 8/15/05 |
| 349S | E | Paint Filter Liquids Test | 006 | 10/26/04 |
| 350S | E | Pest/PCB Extraction – PSEP/PSDDA – Macro-tip | 009 | 2/12/04 |
| 355S | E | SIM-PNA Extraction – Water – Separatory Funnel | 003 | 9/17/03 |
| 357S | E | PNA Extraction – Soil – Micro-tip | 002 | 10/28/04 |
| 359S | E | Sample Screening for PCB/ABN/PNA/PNA-SIM | 006 | 10/27/04 |
| 360S | E | Extractions Opening/Closing Checklist | 005 | 10/28/04 |
| 367S | E | Chlorinated Phenols – Soil – Micro-tip | 003 | 5/2/05 |
| 374S | E | BAN Extraction – PSEP/PSDDA – Macro-tip | 003 | 7/29/03 |
| 377S | E | BAN Extraction – Soil – Micro-tip | 003 | 10/28/04 |
| 381S | E | Soil Extraction – NWTPH-D, AK102, AK103 – ASE | 003 | 11/6/02 |
| 398S | E | EPH Extraction/Fractionation – Soil – Micro-tip | 003 | 9/30/04 |
| 399S | E | EPH Extraction/Fractionation – Water | 004 | 10/15/04 |
| | | **Gas Chromatography** | | |
| 400S | GC | GC Analysis and General Operations | 009 | 7/20/05 |
| 403S | GC | PCB Analysis – EPA Method 8082 | 015 | 9/25/05 |
| 404S | GC | Gasoline Analysis of Soil & Water (NWTPH-G) | 010 | 10/9/04 |
| 405S | GC | Herbicides Analysis – EPA Method 8151 | 008 | 10/15/04 |
| 407S | GC | Diesel Hydrocarbon Analysis (NWTPH-D) | 009 | 5/10/05 |
| 409S | GC | Hydrocarbon Identification (NWTPH-HCID) | 006 | 12/14/05 |
| 410S | GC | BTEX Analysis by GC-PID – EPA Method 8021 | 009 | 10/6/04 |
| 412S | GC | Chlorinated Phenols – EPA Method 8040 | 003 | 10/30/03 |
| 421S | GC | Diesel & Residual Range Organics (AK102-103) | 005 | 10/6/03 |
| 422S | GC | Gasoline Range Organics (AK101) | 004 | 10/15/04 |
| 423S | GC | Pesticides Analysis – EPA Method 8081 | 010 | 9/23/05 |
| 425S | GC | PCB – Congener Analysis – GC-ECD | 001 | 12/27/97 |
| 426S | GC | Glycol Analysis using GC-FID | 004 | 9/10/03 |
| 427S | GC | Water Soluble SVOA via Direct Aqueous Injection | 002 | 6/30/05 |
| 428S | GC | Extractable Petroleum Hydrocarbon | 003 | 7/25/04 |
| 430S | GC | Volatile Petroleum Hydrocarbons | 003 | 10/14/04 |
| | | **Metals Sample Preparation and Analyses** | | |
| 500S | MP | Metals Glassware Prep. | 003 | 10/18/04 |
| 502S | MI | Varian 300Z Graphite Furnace Analysis | 008 | 10/22/04 |
| 505S | MP | Metals Sample Prep. Method 3020A (TWN) | 008 | 9/22/04 |
| 506S | MP | Metals Sample Prep. Methods 7060A/7740 (RMA) | 008 | 9/27/04 |
| 507S | MP | Metals Sample Prep. Method 3050B (SWC) | 008 | 11/3/04 |
| 508S | MP | Metals Sample Prep. Method 3005A (RWC) | 008 | 10/5/04 |
| 509S | MP | Metals Sample Prep. Method 3050B (SWN) | 008 | 11/3/04 |
| 510S | MP | Metals Sample Prep. Method 3010A (TWC) | 008 | 10/5/04 |
| 511S | MP | Metals Sample Prep. Method 7471 (SMM) | 006 | 11/3/04 |
| 514S | MP | Metals Sample Prep. Filter/Wipe (PHN,PNM) | 001 | 11/3/04 |
| 522S | MP | Metals Sample Prep. CLP Method 3005-M (RCN) | 007 | 11/3/04 |
| 525S | MP | Metals Sample Prep. CLP Method 3005-M (RCC) | 007 | 11/3/04 |

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| 526S | MI | Metals Standards Prep. And Maintenance | 006 | 10/20/04 |
| 527S | MI | Metals Spiking | 008 | 10/20/04 |
| 529S | MP | Percent Solids Determination | 004 | 11/3/04 |
| 531S | MP | TCLP Extraction: Method 1311 | 008 | 1/11/06 |
| 532S | MP | Metals Sample Prep. Method 7471A (SWM) | 004 | 11/4/04 |
| 533S | MP | Metals Sample Prep. Method 7470A (TWM) | 005 | 10/5/04 |
| 535S | MP | Metals Sample Prep. Method 200.8 (REC) | 002 | 11/4/04 |
| 536S | MP | Metals Sample Prep. Method 200.8 (REN) | 003 | 10/5/04 |
| 537S | MP | Metals Sample Prep. Method 200.8 (RHN) | 003 | 10/20/04 |
| 538S | MI | Elan 6000 ICP-MS | 005 | 2/5/04 |
| 539S | MI | Cetac Mercury Cold Vapor Analysis | 002 | 10/20/04 |
| 540S | MI | ICP Analysis | 004 | 10/20/04 |
| | | **Wet Chemistry (Conventional) Analyses** | | |
| 600S | CV | Ferrous Iron | 003 | 10/26/04 |
| 601S | CV | Cyanide | 008 | 11/2/04 |
| 602S | CV | TOC – Soil and Sediment | 008 | 3/1/03 |
| 603S | CV | Acidity | 002 | 11/2/04 |
| 604S | CV | Alkalinity | 003 | 3/18/04 |
| 605S | CV | Biochemical Oxygen demand | 004 | 1/9/06 |
| 606S | CV | Bromide | 002 | 11/2/04 |
| 607S | CV | Cation Exchange Capacity | 003 | 11/2/04 |
| 608S | CV | Chlorophyll a | 003 | 11/2/04 |
| 609S | CV | Chemical Oxygen Demand | 002 | 11/2/04 |
| 610S | CV | Color (Visual Comparison) | 003 | 11/2/04 |
| 611S | CV | Conductivity | 003 | 11/2/04 |
| 612S | CV | Chloride (Automated) | 003 | 11/2/04 |
| 614S | CV | Hexavalent Chromium | 004 | 11/2/04 |
| 615S | CV | Ammonia (Automated) | 005 | 4/21/04 |
| 616S | CV | Ammonia (ISE) | 003 | 2/12/04 |
| 617S | CV | Nitrate & Nitrite+Nitrate | 004 | 11/2/04 |
| 618S | CV | pH | 005 | 2/23/06 |
| 620S | CV | Standards Preparation | 003 | 11/2/04 |
| 621S | CV | Ion Chromatography | 005 | 9/24/03 |
| 623S | CV | Fluoride | 003 | 04/19/04 |
| 628S | CV | Microbiology (Coliform) | 002 | 11/2/04 |
| 631S | CV | Phosphorus | 003 | 10/3/03 |
| 632S | CV | Dissolved Oxygen | 003 | 7/14/05 |
| 633S | CV | Phenol | 004 | 10/27/04 |
| 634S | CV | Oxidation/Reduction Potential | 003 | 11/2/04 |
| 635S | CV | Salinity | 002 | 11/2/04 |
| 637S | CV | Sulfate (Automated) | 006 | 11/2/04 |
| 639S | CV | Solids | 005 | 11/2/04 |
| 640S | CV | Sulfide | 002 | 7/14/05 |
| 641S | CV | Sulfite | 002 | 11/2/04 |

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| 642S | CV | Total Kjeldahl Nitrogen | 002 | 7/14/05 |
| 643S | CV | Turbidity | 002 | 11/2/04 |
| 645S | CV | Glassware Cleaning | 002 | 11/2/04 |
| 648S | CV | Hexane Extractable Materials - EPA Method 1664 | 000 | 11/2/04 |
| 649S | CV | TOC-Aqueous | 001 | 11/2/04 |
| | | **Volatile Organic Analyses** | | |
| 700S | VOA | Volatile Organics Analysis – GC/MS | 009 | 7/11/05 |
| 702S | VOA | GC/MS Volatiles – Autosampler Operation | 004 | 11/1/04 |
| 703S | VOA | Volatile Organic Compounds by GC/MS SIM | (Draft) | |
| 704S | VOA | Volatile Organic Standard Preparation | 003 | 11/1/04 |
| 706S | VOA | Volatile Organic Analysis – EPA Method 524.2 | 005 | 2/23/04 |
| 707S | VOA | TCLP/ZHE Extraction for VOA | 001 | 11/01/04 |
| | | **Semi-Volatile Organic Analyses** | | |
| 801S | SVOA | PNA by GC/MS SIM | 006 | 3/14/03 |
| 802S | SVOA | Butyl Tin Species (GC-MS-SIM) | 009 | 5/17/04 |
| 803S | SVOA | Butyl Tin Species in Porewater (GC-MS-SIM) | 007 | 1/10/01 |
| 804S | SVOA | Semivolatile Organics by GC/MS (8270D) | 010 | 7/5/05 |
| | | **Quality Assurance Procedures** | | |
| 1000S | QA | TCLP Extractor RPM Monitoring | 004 | 7/29/05 |
| 1001S | QA | Refrigerator and Freezer Temperature Monitoring | 010 | 8/17/05 |
| 1002S | QA | Laboratory Ethics | 000 | 3/25/05 |
| 1003S | QA | Balance Monitoring | 009 | 10/18/04 |
| 1004S | QA | Document Control – Lab. Forms and Logbooks | 007 | 10/19/04 |
| 1005S | QA | Quality Assessment and Improvement | 009 | 4/5/06 |
| 1006S | QA | Document Control–Standard Operating Procedures | 005 | 9/16/05 |
| 1007S | QA | Internal Chain of Custody-Conventionals | 005 | 10/23/04 |
| 1008S | QA | Internal Chain of Custody-Metals | 005 | 10/18/04 |
| 1009S | QA | Internal Chain of Custody-SVOA | 008 | 9/15/05 |
| 1010S | QA | Internal Chain of Custody-Volatiles | 006 | 10/28/04 |
| 1012S | QA | Standard Preparation – GC and Semivolatiles | 003 | 10/22/04 |
| 1013S | QA | Chemical Receiving and Reagent Preparation | 005 | 5/23/05 |
| 1015S | QA | Pipette Verification | 002 | 10/18/04 |
| 1016S | QA | Control Limits and Control Charts | 003 | 10/19/05 |
| 1017S | QA | Training and Demonstration of Proficiency | 006 | 9/13/05 |
| 1018S | QA | Determination of MDLs and RLs | 005 | 09/11/03 |
| 1019S | QA | Chain of Custody, Archival & Disposal-Org. Ext. | 003 | 10/20/04 |
| 1021S | QA | Manual Integration of Chromatographic Peaks | 000 | 10/29/04 |
| 1022S | QA | Volumetric Ware Verification | 001 | 10/15/04 |

# Appendix F

# Sample Containers, Preservation and Holding Times

# Summary of Sample Containers, Preservatives and Holding Time Requirements

| Parameter | Method Reference | Container Water | Container Soil/ Sed. | Preservation | Holding Time Water | Holding Time Soil |
|---|---|---|---|---|---|---|
| Acidity | 305.1/2310B | 500 mL HDPE | | | 14 Days | |
| Alkalinity | 310.1/2320B | 500 mL HDPE(1) | | | 14 Days | |
| Ammonia | 350.1/4500-NH3 | 500 mL HDPE | 4 oz. WMG | 2 mL (a) | 28 Days | 7 Days |
| Anions ($Cl^-$, $Br^-$, $F^-$, $NO_2^-$, $NO_3^-$, $SO_4^{-2}$, $PO_4^{-3}$) | 300.0/9056 | 500 mL HDPE | 4 oz. WMG | | 48 Hour | 7 Days |
| BETX | 8021/8260 | 2-40 mL vial(1) | 2oz.WMGS(1) | (b) | 14 Days<br>7 Days(2) | 14 Days |
| Biological Oxygen Demand (BOD) | 405.1/5210 | 1 Liter HDPE | | | 48 Hours | |
| Bromide | 300.0/9056<br>4500-Br B | 500 mL HDPE | | | 28 Days | |
| Butyl Tin Species | GC/MS (SIM) | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Cation Exchange Capacity | 9080/MSA 8 & 9 | | 4 oz. WMG | | | 6 Months |
| Chemical Oxygen Demand (COD) | 410.4/5220D | 250 mL AG | 4 oz. WMG | 1 mL (a) | 28 Days | 28 Days |
| Chloride | 325.2/325.3<br>300.0/9056<br>4500-CL | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Chlorophyll a | SM10200H | 1 Liter AHDPE | | | 24 Hours | |
| Coliform, Fecal | SM9222D | Corning 4 oz. | 4 oz. WMG | (d) | 24 Hours | 24 Hours |
| Coliform, Total | SM9222B/9132 | Corning 4 oz. | 4 oz. WMG | (d) | 24 Hours | 24 Hours |
| Color | 110.2/2120B | 500 mL HDPE | | | 48 Hours | |
| Conductivity | 120.1/9050A<br>2510B/MSA 10 | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Corrosivity | SM2330 | 500 mL HDPE | | | 7 Days | |
| Cyanide, Total | 335.2/9010B<br>4500-CN | 500 mL HDPE | 4 oz. WMG | 2 mL (c) | 14 Days | 14 Days |
| Cyanide, Amenable | 335.1/9010B<br>4500-CN G | 500 mL HDPE | 4 oz. WMG | | 48 Hours | 14 Days |
| Cyanide, Weak Acid Dissociable (WAD) | SM4500 CN I | 500 mL HDPE | 4 oz. WMG | 2 mL (c) | 14 Days<br>48 Hours(2) | 14 Days |
| Dissolved Oxygen | 360.2/4500-O C | BOD bottle | | fixed in field | 8 Hours | |
| HEM / HEM-SGT | 1664 / 9071 | 1 Liter AG | 4 oz. WMG | 5 mL (a) | 28 Days | 28 Days |
| FOG (Fats/Oils/Grease ) | 5520B/413.1 | 1 Liter AG | 4 oz. WMG | 5 mL (a) | 28 Days | 28 Days |
| Fecal Streptococci | SM9230C | Corning 4 oz. | 4 oz. WMG | (d) | 24 Hours | 24 Hours |
| Fluoride | 340.2/300.0<br>9214/9056<br>4500-F B | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Herbicides | 8151A | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Hardness (Calculation) | 6010/2340B | 500 mL HDPE | | 5 mL (f)(3) | 6 Months | |
| Hexavalent Chromium ($Cr^{+6}$) | 7196A<br>3500 CR-D | 500 mL HDPE | 4 oz. WMG | | 24 Hours | 28 Days |
| Iodide | 345.1 | 500 mL HDPE | | | On Receipt | |
| Iron, Ferrous ($Fe^{+2}$) | 3500FE D | 500 mL AG | | 2 mL (b) | On Receipt | |
| Metals | 6010/7000/<br>200.8 series | 500 mL HDPE | 4 oz. WMG | 5 mL (f)(3) | 6 Months | 6 Months |
| Mercury | 7470/7471 | 500 mL HDPE | 4 oz. WMG | 5 mL (f)(3) | 28 Days | 28 Days |
| Nitrate | 353.2/300.0<br>9056<br>4500-NO3 F | 500 mL HDPE | 4 oz. WMG | | 48 Hours | 7 Days |
| Nitrate + Nitrite | 353.2/300.0<br>9056<br>4500-NO3 F | 500 mL HDPE | 4 oz. WMG | 2 mL (a) | 28 Days<br>48 Hours (2) | 7 Days |

# Summary of Sample Containers, Preservatives and Holding Time Requirements

| Parameter | Method Reference | Container Water | Container Soil/ Sed. | Preservation | Holding Time Water | Holding Time Soil |
|---|---|---|---|---|---|---|
| Oil & Grease (See FOG) | | | | | | |
| Organophosphorous Pesticides | 8141 | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Pentachlorophenol | 8041-M/8270D | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Pesticides/PCBs | 8081A/8082 | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Petroleum Hydrocarbon-Diesel (TPH-D) (DRO) | NWTPH-Dx AK102 | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Petroleum Hydrocarbon-ID (HCID) | NWTPH-HCID 8015M | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Petroleum Hydrocarbons-Gas (TPH-G) (GRO) | NWTPH-G AK101 | 2 - 40 mL vial(1) | 2oz.WMGS(1) | (b) | 14 Days 7 Days(2) | 14 Days |
| pH | 150.1/9040B 9045C/4500-H+ | 500 mL HDPE | 4 oz. WMG | | 24 Hours | 14 Days |
| Phenols, GC/FID | 8041M | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Phenols, Total | 420.1/5530 | 500 mL HDPE | 4 oz. WMG | 2 ml (a) | 28 Days | 28 Days |
| Phosphorous, Total | 365.2 4500-P B | 500 mL HDPE | 4 oz. WMG | 2 ml (a) | 28 Days | 28 Days |
| Phosphorous, Ortho (Soluble Reactive Phosphorous – SRP) | 365.2/300.0 9056/4500-P E | 500 mL HDPE | 4 oz. WMG | | 48 Hours | 28 Days |
| Polynuclear Aromatic Hydrocarbon-PAH | 8270D & SIM | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Salinity | SM2520B | 500 mL HDPE | | | 28 Days | |
| Semivolatile Organics | 8270D | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Solids, Total (TS) | 160.3/2540 B | 1 Liter HDPE | 4 oz. WMG | | 7 Days | 14 Days(5) |
| Solids, Total Suspended (TSS) | 160.2/2540 D | 1 Liter HDPE | | | 7 Days | |
| Solids, Total Dissolved (TDS) | 160.1/2540 C | 1 Liter HDPE | | | 7 Days | |
| Solids, Total Volatile (TVS) | 160.4/2540 E | 1 Liter HDPE | 4 oz. WMG | | 7 Days | 7 Days |
| Solids, Settleable (SS) | 160.5/2540 F | 1 Liter HDPE | | | 48 Hours | |
| Solids, Volatile Suspended (TVSS) | SM2540E | 1 Liter HDPE | | | 7 Days | |
| Sulfate | 375.2/300.0 9036/9056 4500-SO4F | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Sulfide, Acid Volatile (AVS) | EPA 1991 | 500 mL HDPE(1) | | | | 14 Days |
| Sulfide | 376.2 4500S2 D 9030B | 500 mL HDPE(1) | 2 oz.WMGS(1) | 2 ml (e) + 1 mL (c) pH > 9.0 | 7 Days | 7 Days |
| Sulfite | 377.1 4500-SO3B | 500 mL HDPE | | | 24 Hours | |
| Total Kjeldahl Nitrogen (TKN) | 351.2/351.3 4500-NORG | 500 mL HDPE | 4 oz. WMG | 2 ml (a) | 28 Days | 28 Days |
| Total Organic Carbon (TOC) | 415.1/5310B 9060/Plumb(4) | 250 mL AG | 4 oz. WMG | 1 ml (a) | 28 Days | 28 Days |
| Turbidity | 180.1/2130 B | 500 mL HDPE | | | 48 Hours | |
| Volatile Organic Compounds | 524.2/624 8260/8260SIM | 3-40 mL vial(1) | 2 oz.WMGS(1) | (b) | 14 Days 7 Days(2) | 14 Days |

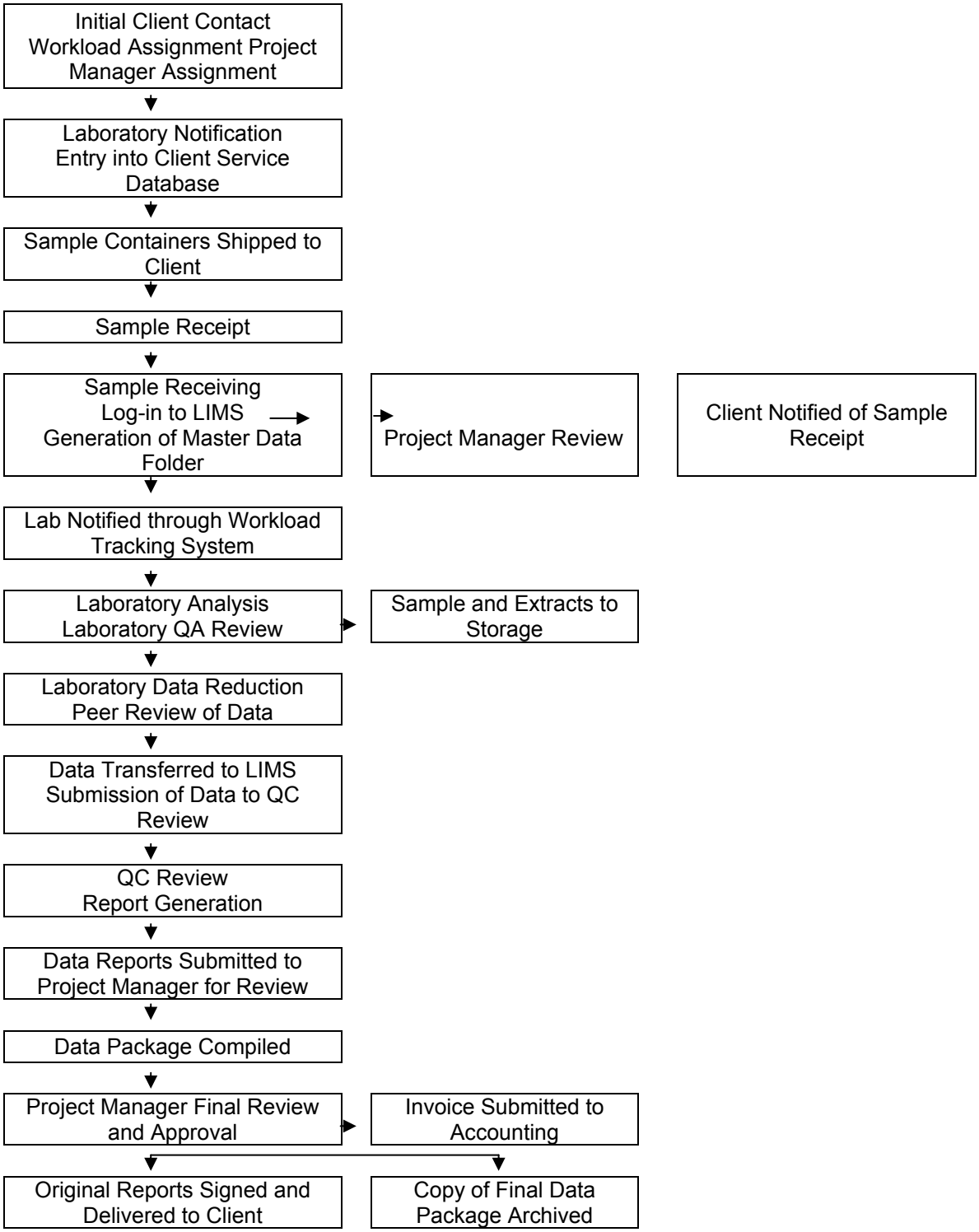
**Containers:**
AG = Amber Glass Boston Round Bottle
WMG = Wide Mouth Glass Jar
WMGS = Wide Mouth Glass Jar with Septa
HPDE = High Density Polypropylene
AHPDE = Amber HPDE

**Preservation:**
(a) = 9N $H_2SO_4$
HCl to pH<2.0
(c) = 10N NaOH
(d) = $Na_2S_2O_3$ (Sodium Bisulfite) Tablet
(e) = 2N ZnOAc
(f) = 1:1 $HNO_3$

**Notes:**
(1) = No Headspace
(2) = When Unpreserved
(3) = Total Metals or field filtered samples only
(4) = Plumb, R. H. Jr., *Procedures for Handling and Chemical Analysis of* (b) (b) = *Sediment & Water Samples*, May 1981, USACE Publication AD/A103788
(5) = When requested as a separate analyte. TS to correct for dry weight has the same holding time as the analytical parameter

# Appendix G

# Laboratory Workflow


Initial Client Contact
Workload Assignment Project Manager Assignment
Laboratory Notification
Entry into Client Service Database
Sample Containers Shipped to Client
Sample Receipt
Sample Receiving
Log-in to LIMS
Generation of Master Data Folder
Project Manager Review
Client Notified of Sample Receipt
Lab Notified through Workload Tracking System
Laboratory Analysis
Laboratory QA Review
Sample and Extracts to Storage
Laboratory Data Reduction
Peer Review of Data
Data Transferred to LIMS
Submission of Data to QC Review
QC Review
Report Generation
Data Reports Submitted to Project Manager for Review
Data Package Compiled
Project Manager Final Review and Approval
Invoice Submitted to Accounting
Original Reports Signed and Delivered to Client
Copy of Final Data Package Archived

# Appendix H

# Analytical Methods

# ORGANIC ANALYSES

| Parameter | Methods | Technique |
|---|---|---|
| **Volatiles (GC/MS)** | 524.2/624/8260B | GC/MS |
| | Low Level Vinyl Chloride & 1,1 – Dichloroethene | GC-MS-SIM |
| **Volatiles (GC)** | | |
| Volatile Aromatics | 602/8021B | GC/PID |
| **Semivolatiles (GC/MS)** | | |
| Semivolatile Organics | 625/8270D | GC/MS |
| Polynuclear Aromatic Hydrocarbons (PNA/PAH) | 625/8270D | GC/MS (SIM) |
| Isotope Dilution Semivolatiles | 1625 | GC/MS |
| Butyl Tin Species | Krone (1988) | GC/MS-SIM |
| **Pesticides/GC Analyses** | | |
| Chlorinated Pesticides | 608/8081A | GC/ECD |
| Aroclors/PCBs | 608/8082 | GC/ECD |
| PCB Congeners | ARI Method | GC/ECD |
| Phenols | 604/8041 | GC/FID |
| Chlorinated Phenols | 8041 (mod) | GC/ECD |
| Pentachlorophenol | 8151A (mod) | GC/ECD |
| Organophosphorous Pesticides | 614/8141A | GC/NPD |
| Polynuclear Aromatic Hydrocarbons (PNA/PAH) | 610/8100 | GC/FID |
| Chlorinated Hydrocarbons | 612/8121 | GC/ECD |
| Herbicides | 615/8151A | GC/ECD |
| Glycols | ARI Method(SOP 426S R2) | GC/FID |
| Hydrocarbon ID | NWTPH-HCID | GC/FID |
| Gasoline Range Hydrocarbons | (N)WTPH-G/AK101/WI-GRO | GC/FID |
| Diesel Range Hydrocarbons | (NWTPH-D/AK102/WI-DRO) | GC/FID |
| Extractable Petroleum Hydrocarbons | ARI Method | GC/FID |
| Volatile Petroleum Hydrocarbons | ARI Method | GC/PID |
| **Organic Sample Preparation and Clean Up** | | |
| TCLP / SPLP Extraction | | 1311 / 1312 |
| Sonication | | 3550B |
| Soxhlet | | 3540C |
| Accelerated Solvent Extraction (ASE) | | 3545B |
| Separatory Funnel | | 3510C |
| Continuous Liquid-Liquid | | 3520C |
| Alumina Clean-up | | 3610B |

| | |
|---|---|
| Florisil Clean-up | 3620B |
| Gel Permeation (GPC) | 3640A |
| Silica Gel | 3630C |
| Sulfur Clean-up | 3660B |
| Sulfuric Acid Clean-up | 3665A |

# INORGANIC ANALYSES

| Parameter | Methods | Technique |
|---|---|---|
| **Wet Chemistry** | | |
| Acidity | 2310/305.1 | Titrimetric |
| Alkalinity | 2320/310.1 | Titrimetric |
| Ammonia | 4500$NH_3$H/350.1 | AutomatedPhenate/ISE |
| Biological Oxygen Demand-BOD | | |
| Carbonaceous – BOD | 5210.B/405.1 | 5-day Winkler Titration |
| Bromide | 4500Br.B | Phenol Red Colorimetric |
| Anions | 300.0 | Ion Chromatography |
| Cation Exchange Capacity | 9080 | Neutral Ammonium Acetate |
| Chemical Oxygen Demand | 5220.D/410.4 | Closed Reflux, Colorimetric |
| Chromium Hexavalent (Cr6+) | 3500Cr-D/7196A | Diphenylcarbazide |
| Chloride | 4500Cl.E/325.2 | Automated Ferricyanide |
| Chlorophyll a | 10200.H | Spectrophotometric |
| Coliform, Total / Fecal | 9222.B/D | Membrane Filtration |
| Color | 2120.B/110.2 | Visual Comparison |
| Conductivity | 2510/120.1 | Electrometric |
| Corrosivity (CaCO3 Saturation) | 2330 | Calc. (pH, Alk, TDS, Ca) |
| Cyanide, Total | 4500CN.C/335.2/9010 | PBA, Colorometric |
| Cyanide, Amenable | 4500CN.G/335.1 | Alkaline Chlorination |
| Cyanide, WAD | 4500CN.I | Weak Acid Distillation |
| Dissolved Oxygen | 4500-O.C/360.2 | Winkler Titration |
| Fats/Oils/Grease | 5520.B/413.1/9070A | Gravimetric |
| Fluoride | 4500F.C/340.2 | Ion Specific Electrode |
| | 300.0 | Ion Chromatography |
| Formaldehyde | ASTM D-19 P216 | Colorimetric |
| Hardness, Calculation | 2340.B/6010B | Ca, Mg Calculation |
| Heterotrophic Plate Count | 9215.D | Membrane Filtration |
| Iron (II) ferrous | 3500Fe.D | Phenanthrolene |
| Nitrate + Nitrite | 4500$NO_3$F/353.2 | Automated Cd Reduction |
| Nitrate | 4500$NO_3$F/353.2 | Calculated |
| | 300.0 | Ion Chromatography |
| Nitrite | 4500$NO_3$.F/353.2mod | Automated Colorimetric |
| | 300.0 | Ion Chromatography |
| Oil & Grease, Solids | 5520.D/907 | Gravimetric |
| Oil & Grease, Polar/Non Polar | 5520.F | Gravimetric |
| PH | 150.1 | Electrometric |
| Phenols | 5530.D/420.1/9065 | 4-AAP w/ Distillation |
| Phosphorous, Total | 4500P.B/365.2 | Colorimetric w/ digestion |

| | | |
|---|---|---|
| Phosphorous, Ortho (SRP) | 4500P.B/365.2 | Colorimetric |
| | 300.0 | Ion Chromatography |
| Salinity | 2520 | Conductimetric |
| Silicate | 4500Si.E/370.1 | Heteropoly Blue |
| Total Kjeldahl Nitrogen (TKN) | 4500N.org/351.4 | Block Digest/ISE |
| Total Solids | 2540.B/160.3 | Gravimetric, 104°C |
| Total Suspended Solids (TSS) | 2540.D.160.2 | Gravimetric, 104°C |
| Total Dissolved Solids (TDS) | 2540.C/160.1 | Gravimetric, 180°C |
| Total Volatile Solids (TVS) | 2540.E/160.4 | Gravimetric, 550°C |
| Settleable Solids | 2540.F | Volumetric |
| Streptococcus, Fecal | 9230.C | Membrane Filtration |
| Sulfide | 4500$S^2$.E/376.1/9034 | Iodometric |
| Sulfide, Low Level | 4500$S^2$.D/376.2 | Methylene Blue |
| Sulfide, Acid Volatile | 4500$S^2$.D/376.2 | Methylene Blue |
| Sulfate | 4500$SO_4^2$.F/375.2/9036 | Auto. Methylthymol Blue |
| | 300.0 | Ion Chromatography |
| Sulfite | 4500$SO_3^2$.B.377.1 | Iodometric |
| Total Organic Carbon (TOC) | 5310.B415.1/PSEP | Combustion NDIR |
| Turbidity | 2130.B/180.1 | Nephelometric |
| Total Lipids in Tissue | Bligh & Dyer (mod) | Gravimetric |

**Trace Metals Analyses**

**Inductively Coupled Plasma (ICP):**

| | | |
|---|---|---|
| Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Th, Ti, Tl, V, (Li, Th, U, W - special request only) | Zn200.7 / 6010B | ICP |

**Graphite Furnace (GFAA)**:

| | | |
|---|---|---|
| Ag, As, Cd, Sb, Pb, Se, Tl | 200 Series / 7000 Series | GFAA |

**Cold Vapor (CVAA):**

| | | |
|---|---|---|
| Hg | 7470A/7471A | CVAA |

**Inductively Coupled Plasma/Mass Spectroscopy (ICP-MS):**

| | | |
|---|---|---|
| Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Th, Tl, U, V, Zn | 200.8/ 6020 Mod. | ICP/MS |

**Trace Metals Sample Preparation**

| | |
|---|---|
| Toxicity Characteristic Leaching Procedure | 1311 |
| Synthetic Precipitation Leaching Procedure | 1312 |
| Digestion for Total Recoverable or Dissolved Metals | 3005A |
| Digestion of Aqueous Samples for Total Metals by ICP | 3010A |
| Digestion of Aqueous Samples for Total Metals by GFAA | 3020A |
| Digestion of Sediment, Sludge and Soil | 3050B |

# Appendix I

## Method Detection Limits
## Reporting Limits

Summaries of method specific MDL studies and reporting limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-CLs.zip

MDL's and reporting are updated periodically. Assure that you have ARI's current detection limit data by downloading the files at the time of use.

# Appendix J

# Quality Control Limits

Method specific control limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use.

# Appendix K

# Internal Audit Schedule

## Schedule of Laboratory Quality Assurance Audits

| Process To Be Audited | Frequency |
|---|---|
| Refrigerator/Freezer Temperature Logs | Monthly* |
| Oven/Incubator Temperature Logs | Monthly* |
| Balance Records | Quarterly* |
| Standard Records | Monthly# |
| Logbooks | Monthly# |
| SOPs | Monthly# |
| Chain of Custody | Monthly# |
| Internal Technical Systems | Annually |
| Post-Completion Project Review | Monthly** |

* all sections will be audited

# one section will be audited each month

** frequency may be contract specific i.e. 10% of NFESC projects must be audited

# Appendix L

# Laboratory Accreditations

## Laboratory Accreditations

Analytical Resources Inc. is currently certified to perform environmental analysis by the State of Washington Department of Ecology, the State of Washington Department of Health and selected other states. ARI has also been accredited to perform various analyses for HAZWRAP (Hazardous Waste Remedial Actions Program), NEESA (Naval Energy and Environmental Support Activity), and the Navy Clean program.

ARI's laboratory QA/QC Program has been audited and approved by the USEPA Contract Laboratory Program for both organic and inorganic, the U.S. Army Corps of Engineers, The Boeing Company and Battelle Northwest Laboratories.

ARI analyzes performance evaluation samples quarterly for the EPA-CLP Program and semiannually for the EPA Water Pollution (WP) and Water System (WS) series. Also, all ARI laboratories periodically analyze blind in-house Performance Evaluation Samples as part of the laboratory QA/QC Program.

### List of Accreditations

1) State of Washington, Department of Ecology - Environmental Laboratory Accreditation Program
2) The Alaska State Department of Environmental Conservation - Laboratory Approval Program
3) United States Army Corps of Engineers (US ACOE)
4) United States Naval Facilities Engineering Service Center (NFESC) (formerly known as NEESA)

### Continuing Contracts Resulting from On-Site Laboratory Audits

1) The Boeing Company Corporate Environmental Affairs Division
2) Battelle Northwest Laboratories
3) The City of Seattle
4) The Port of Seattle

# Appendix M

# Data Reporting Qualifiers

# Data Reporting Qualifiers

**Effective 12/28/04**

## Inorganic Data

U Indicates that the target analyte was not detected at the reported concentration

* Duplicate RPD is not within established control limits

B Reported value is less than the CRDL but ≥ the Reporting Limit

N Matrix Spike recovery not within established control limits

NA Not Applicable, analyte not spiked

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD

## Organic Data

U Indicates that the target analyte was not detected at the reported concentration

* Flagged value is not within established control limits

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J Estimated concentration when the value is less than ARI's established reporting limits

D The spiked compound was not detected due to sample extract dilution

NR Spiked compound recovery is not reported due to chromatographic interference

E Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.

S Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte

NA The flagged analyte was not analyzed for

NS The flagged analyte was not spiked into the sample

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a “tentative identification”

Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

C The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column

P The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference

## Geotechnical Data

A The total of all fines fractions. This flag is used to report total fines when only sieve analysis is requested and balances total grain size with sample weight.

F Samples were frozen prior to particle size determination

SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations

SS Sample did not contain the proportion of “fines” required to perform the pipette portion of the grain size analysis

W Weight of sample in some pipette aliquots was below the level required for accurate weighting

# Appendix N

# Standards for Personal Conduct

## Standards of Conduct

Since effective working relationships depend upon each of us, ARI expects certain minimum standards of personal conduct.

This list highlights general Company expectations and standards and does not include all possible offenses or types of conduct which may result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

Employees engaged in the following activities, or similar activities deemed equally serious, will normally be terminated:

theft or embezzlement
disclosure of trade secrets or industrial espionage;
willful violation of safety or security regulations;
conviction of a felony;
working for a competitor or establishing a competing business.

In addition, dismissal may result from other serious offenses such as:

being intoxicated, under the influence or in possession of illegal drugs on the job;
falsification of records;
abuse, destruction, waste or unauthorized use of equipment, facilities or materials;
gambling on the premises;
chronic tardiness or absenteeism;
insubordination;
unwillingness to perform the job;
unauthorized requisition of materials from vendors.

There may be no alcoholic beverages on the Company premises, other than at times designated as Company functions. At such times, non-alcoholic beverages will be provided as well.

Personal and corporate honesty and integrity have built the character of ARI. This good character is fundamental to our well-being, future growth and progress. It is vitally important that we avoid both the fact and the appearance of conflicts of personal interest with that of the firm, its clients, and any other professional contacts.

This policy requires that ARI employees have no relationships or engage in any activities that might impair their independence of judgment. Employees must not accept gifts, benefits, or hospitality that might tend to influence them in the performance of their duties. It is expected that there will be no employment by any competing company, nor any

employment by any outside interest or engagement in outside activity which might impair an employee's ability to render the full-time service to the company that employment involves.

If any possible conflict of interest situation arises, the individual concerned must make prior disclosure of the facts so that action may be taken to determine whether a problem exists and, if so, how best to eliminate it. Likewise, any financial interest in an organization doing business with ARI or which competes with us should be revealed to Company management. (Excluded from this requirement is ownership of securities traded in major stock exchanges or other recognized trading markets.)

Our standards are those generally expected of employees in any well-regarded, ethical business organization.

ARI further expects that each employee will:

Be dressed and groomed appropriately for a business office. Employees in the laboratory areas are expected to dress in compliance with established safety procedures. Specific standards will be discussed with each employee during Health and Safety orientation. Your supervisor and the Administrative Services Manager always are available to answer questions.

## Standards of Personnel Conduct – continued

Maintain the confidential nature of Company information. Removal of Company documents, records, stored materials, computer printouts, or any similar information, or copies of such material or information from the office without specific permission is prohibited. Likewise, revealing confidential information to an unauthorized person or using such information in an unauthorized way is prohibited. If there could be any possible question about the applicability of this requirement to a given circumstance, ask your supervisor.

Use Company computer capabilities and facilities only for authorized business at authorized times and locations; observe strictly all computer security measures and precautions; enter, alter or delete no computer instructions or stored material apart from that required by faithful performance of assigned duties; remove, copy, use or permit to be used no computer software developed for, purchased by, or otherwise used by ARI except as required by faithful performance of assigned duties.

Conduct business dealings with clients and members of the public in a courteous manner.

# Appendix O

# Quality Assurance Policies

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 1**

**SUBJECT: CORRECTIONS TO DATA/BENCHSHEETS**

**DATE: 8/2/96**

Manual corrections made on any raw data, bench sheet, logbook or document used during sample processing will be made in the following manner:

1. Draw a single line through the information to be deleted or corrected. The original information must remain readable.

2. Enter any new information, preferably above the original information.

3. Initial and date the correction.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 2**

**SUBJECT: LINING OUT UNUSED BENCHSHEET PORTIONS**

**DATE: 8/2/96**

All unused portions of logbook pages and benchsheets will be lined through so that information cannot be added at a later date. This will be completed in the following manner:

1. Line out unused portions of a logbook page or benchsheet by drawing a single line or "Z" through the unused portions.

2. Initial and date the page beside the lineout.

3. Do not line out a page or section until it is certain that no additional information will be added to the unused portions.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 3**

**SUBJECT: STOP WORK ORDERS**

**DATE: 8/28/96**

It is the responsibility of all staff members to address situations that may require the issuance of a "stop work order". Potential and actual "stop work orders" will be handled as follows:

1. If an analyst or technician observes a situation which will or may have a negative impact on data quality, that person will notify her/his section supervisor immediately.

2. The section supervisor will assess the situation. If it appears that a "stop work order" may be required, the section supervisor will notify the appropriate manager (inorganic or organic).

3. The supervisor and manager will then decide if a "stop work order" should be issued. The manager will make a final decision on whether or not to issue a "stop work order". The incident will be reported to the Quality Assurance Program Manager using a Corrective Action Request form.

4. If a "stop work order" is issued, the manager will inform the Project Managers and the QA section. The section supervisor will notify section staff of the order.

5. The laboratory manager involved will oversee the development and implementation of a Corrective Action Plan (CAP). Upon completion of the CAP the "stop work order" may be rescinded.

6. Prior to rescinding a "stop work order", verification must be made that control has been regained and that work may begin. Only the inorganic or organic manager may rescind a "stop work order".

7. When the "stop work order" is rescinded, the Project Managers, analytical staff and QA section will be notified. The QA section will require documentation verifying that the procedure is back in control.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 4**

**SUBJECT: SOP Review**

**DATE: 9/3/96**

All Standard Operating Procedure (SOP) documents will be reviewed and updated at least annually by qualified staff members. Laboratory management will review and approve all modifications to the SOPs.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER:** 5

**SUBJECT:** Reporting Dilutions

**DATE:** 9/11/96

Dilution factors will be recorded as whole numbers followed by "X" (i.e., 5X, 10X, etc.). This reporting convention will be used on run logs, bench sheets, raw data and final reports for all diluted samples, extracts or digestates or standards.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 6**

**SUBJECT: Formatting for SOPs – Computer Related**

**DATE: 1/31/00**

Conventions for formatting computer-related instructions in SOPs

Commands should be indented and formatted as **`bold courier`** and one or two font sizes smaller:

```
USE PARAMS ORDER PARAMS
BROW
```

Many systems and languages are *case-sensitive*, and case should match the syntax and/or stylistic standards of the language.

If only one command, like ***SET CENTURY ON***, is needed, it can be included in the rest of the text, so long as it is also italicized.

If the user must substitute a particular value in place of a general descriptor, italicize the descriptor, make it lowercase, and *do not make it bold*:

```
USE PARAMS ORDER PARAMS
COPY TO TEMPARM FOR JOB = 'job' .AND. SAMPLE = 'sample'
```

In general, keywords, variable names, formatting codes, and descriptors should be in *`courier`* and *`italicized`*.

# QUALITY ASSURANCE POLICY

| | |
|---|---|
| **POLICY NUMBER:** | **7** |
| **SUBJECT:** | **Manual Adjustment of Data** |
| **DATE of IMPLEMENTATION:** | **1/1/01** |

Modern chromatographic instruments include computer software to identify a detector response as a chromatographic peak, characterize that peak and determine the relative height or area of the signal. The software utilizes parameters (threshold, slope, etc) that are adjusted by the instrument operator to optimize the results.

A single set of operator controlled settings that determine peak characteristics for an entire data file is defined as an "automated procedure". An automated procedure often characterizes chromatographic peaks incorrectly. ARI requires that trained analysts identify and resolve these errors using an alternate automated procedure or a "manual adjustment" of the data. Manual adjustment is defined as the process used by an analyst to adjust an individual peak or a subset of data in a chromatographic file.

1. The settings for a routine automated procedure normally used to process chromatographic data must be described in the method Standard Operating Procedure (SOP).

2. Trained analysts may substitute one automated procedure for another in order to optimize peak characteristics. The use of an alternate automated procedure must be permanently documented using either a software generated log file or analyst notes.

3. Manual adjustment of chromatographic peak characteristics will be used to correct the results of an automated procedure that, in a trained analyst's opinion, are clearly incorrect and will result in erroneous peak identification, integration or quantification.

4. Manual adjustment will be implemented in a reasonable and consistent manner. Guidelines for performing manual adjustment will be documented in method SOPs.

5. All manually adjusted data will be clearly identified for approval in the data review process. A permanent record of all manual adjustments will be maintained in both electronic and hardcopy versions of the raw data.

6. Manual adjustment of chromatographic files will not be used to falsify data for any purpose. Falsification of data through the use of manual peak adjustment is unethical, unlawful and will result in termination of the offending analyst.

Approval:

_____

Quality Assurance Program Manager Date

# QUALITY ASSURANCE POLICY

| | |
|---|---|
| **POLICY NUMBER:** | **8** |
| **SUBJECT:** | **Performance Evaluation Samples** |
| **IMPLEMENTATION DATE:** | **1/1/01** |

Performance Evaluation Samples (PES) will be analyzed on a periodic basis to monitor laboratory performance and/or meet the requirements of an external accreditation program. PES samples contain target analytes in concentrations unknown to laboratory personnel. PES may be submitted by a third party or prepared internally under the direction of ARI's QA personnel.

PES will be submitted blind to the laboratory whenever possible.

PES will be logged-in, prepared, analyzed and reported as a routine sample without special consideration.

# QUALITY ASSURANCE POLICY

| | |
|---|---|
| **POLICY NUMBER:** | **9** |
| **SUBJECT:** | **Modifications to Analytical Methods Procedures or Reports** |
| **DATE of IMPLEMENTATION:** | **8/24/05** |

This Policy defines the processes used to initiate and validate modifications to analytical processes, QA/QC protocol, data processing programs and algorithms, data reporting formats or other changes to analytical procedures or SOPs at Analytical Resources Inc. (ARI). The procedures outlined will also be used to validate project specific changes to analytical protocol and new analytical methods.

Changes to analytical procedures must be approved by ARI's Management (Managers and/or Supervisors) and be well documented using the following procedure:

1. Modification may be requested by any staff member. The modification must be requested using ARI's Corrective Actions Tracking System. Corrective Action requests for changes to analytical protocol or reports will assigned to the appropriate manager or supervisor by the initiator. As an alternative the request may be assigned to the QA Section. The Corrective Actions assignee may approve the project or re-assign the request for approval to a third party. The QA Section will monitor the progress of all requests.

2. The requestor must detail and justify the proposed modifications or additions when initiating a Corrective Action issue. Modifications must be approved by ARI management prior to any work performed to establish the modification.

3. The following must be in place before final approval and/or implementation of the proposed modification.

A. A new or revised SOP as appropriate including the modification or new protocol.
B. An Initial Demonstration of Proficiency as defined in ARI SOP 1018S for new or modified analytical procedures.
C. An MDL study following the procedure in ARI SOP 1018S for new or modified analytical procedure.
D. When appropriate, successful analysis of a blind Performance Evaluation Sample using new or modified procedures or data processing protocol.
E. Documentation that new or modified software provides the desired result.

4. ARI staff must have sufficient training to implement the procedural changes.

5. Notification of the modifications must be distributed to all affected personnel including appropriate client personnel.

# QUALITY ASSURANCE POLICY

| | |
|---|---|
| **POLICY NUMBER:** | **10** |
| **SUBJECT:** | **Reporting of Target and Spiked Analytes For Dual Column GC Analyses** |
| **DATE of IMPLEMENTATION:** | **8/24/05** |

Analytical Resources Inc. uses single injection, dual column gas chromatographs to simultaneously identify and confirm the presence of target or spiked analytes in some GC analyses. Only one quantitative value is reported for each target or spiked analyte. ARI's policy for deciding which value to report is outlined as follows:

1. ARI considers each column equally valid for compound identification and quantification. Both GC columns must be compliant with all quality assurance parameters outlined in ARI's SOPs and LQAP. Both GC columns must produce valid initial and continuing calibrations using the same calibration model.

2. The analytical value reported will be determined by comparison of the quantitative results of confirmed analytes as follows.

a. The relative percent difference (RPD) between the results on the two columns ($R_1$ & $R_2$) is calculated using the formula:

$$RPD = \frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} \times 100$$

b. If the RPD is less than 40% the greater of the two values is reported for both target analytes and spiked compounds. When required by specific QA protocol, by contract or client request the lower value will be reported for target analytes.

c. If the RPD is greater than 40%, ARI's analyst must examine the chromatogram for anomalies (overlapping peaks, incorrect integration, negative peaks) and either correct the anomalies (i.e. perform manual integrations) or report the most appropriate target analyte value. The higher value will be reported for spiked analytes. ARI's analyst must provide a written evaluation of all analyses where an RPD exceeds 40% and this information must be passed on to ARI's client or the data user.

# Appendix P

# Modifications to the LQAP

# Modifications to ARI's LQAP

| New Revision | Date | Modifications |
|---|---|---|
| 12-007 | 4/11/06 | 1. Removed Appendix J – Tuning Criteria are in the SOP<br>2. Changed BOD RL from 1 to 2 ppm<br>3. Integrated all SVOA Soil/Sediment MDLs into One Table<br>4. Added SIM Analysis to Soil/Sediment SVOA MDL Table<br>5. Added SIM Analysis to Water SVOA MDL Table<br>6. Updated MDL for SVOA in Water<br>7. Updated MDLV for Pesticides in Soil (25g to 5mL)<br>8. Updated MDLV for Pesticides in Soil (12g to 4mL)<br>9. Updated MDLV for PCB in Water (500 to 1mL)<br>10. Updated MDLV for PCB in Water (500 to 5mL)<br>11. Updated MDLV for Chlorinated Phenols in Water (500 to 50mL)<br>12. Removed Appendix I – MDL & RL Summaries<br>13. UpdatedMDL for SIM-PNA<br>14. Updated MDLV for SIM-PNA<br>15. Removed Appendix K – Control Limits |
| 12-006 | 1/16/06 | 1. Updated MDL for TBT in Pore Water<br>2. Updated MDL and MDLV for Toxaphene in Soil/Sediment<br>3. Updated MDLV for VOA 8260B 20 mL Purge<br>4. Added IDL, MDL & RL for Low RL Mercury<br>5. Updated all Metals MDL Verifications<br>6. Updated MDLV for Water VOA using 5 mL purge<br>7. Updated MDLV for PCB in Soil with Soxhlet Extraction<br>8. Updated MDLV for SVOA (8270D) Analysis of Water using SepFunnel<br>9. Updated MDL for GC-MS-SIM Analysis of Skydrol & BHT in Water<br>10. Updated MDL for Chlorophenols (8041) in Soil<br>11. Modified RL for Chlorophenols in Soil & Tissue<br>12. Added Headspace GC (FID5) to Instrument List<br>13. Updated Footnotes on Glycols RL Table<br>14. Modified RL for 1,4-Dioxane in Water Method 8270D<br>15. Updated MDL for Analysis of Soil for VOA<br>16. Updated MDL for Analysis of Soil for JP-8<br>17. Updated MDL for Analysis of Sediment for TBT<br>18. Updated MDLV for Analysis of TBT in Water and Tissue<br>19. Added MDL for Analysis of PCB in Tissue with 4 ppb RL<br>20. Updated MDLV for PCB Analysis of Soil (Soxhlet) and Tissue (4 ppb)<br>21. Updated MDLV for Manchester Analysis of PCB in Water<br>22. Updated MDLV for Analysis of Gasoline in Soil and Water<br>23. Updated MDLV for Analysis of BTEX in Soil and Water<br>23. Updated MDLV for Analysis of Motor Oil in Soil and Water<br>24. Upadted MDLV for Analysis of VOA-SIM in Water<br>25. Upadted MDLV for Analysis of VOA (20 mL) in Water<br>26. Updated MDL Table for Convntionals<br>27. Updated MDLV for Pesticides in Water (500 to .5 mL)<br>28. Updated MDLV for PCB Analysis of Soil<br>29. Updated MDLV for Chlorophenols (8041) in Soil<br>30. Updated MDLV for JP4 in Water and Soil<br>31. Updated MDLV for JP8 in Soil<br>32. Updated MDLV for VOA (8260B) in Water 5 mL & 20 mL Purge Volumes<br>33. Updated MDL for PCB in Soil – Standard Analysis & Medium Level<br>34. Updated MDL for Pesticides in Water – Standard Analysis<br>35. Updated MDL for SVOA in Water – Liq-Liq Extraction<br>36. Updated MDLV for Chlorophenols in Water |
| 12-005 | 10/24/05 | 1. Added MDL for Chlorinated Phenol Analysis of Tissue (Method 8041)<br>2. Modified QA Policy 10 |

| | | |
|---|---|---|
| | | 3. Established Implementation Date for QA Policies 09 & 10<br>4. Updated MDLV for TBT in Water<br>5. Corrected MDL Value for bis-(2-Ethylhexyl)-phthalate in SVOA Tissue<br>6. Updated MDL for Pesticides in Soil<br>7. Modified Title Format of Selected MDL Tables<br>8. References to 8270 or 8270C changed to 8270D<br>9. Deleted MDL Tables for SVOA Analyses of Tissue<br>10. Updated MDLs for SIM-PNA in Water (SepFunnel) and Soil<br>11. Updated MDLV for Metals<br>12. Updated MDLV for Manchester Pesticides<br>13. Updated MDLV for TPH-D In Soil<br>14. Updated MDLV for SIM-PNA in Water with Liq-Liq Extraction<br>15. Updated MDLV for JP-4 in Soil<br>16. Updated MDLV for VOA Water 5 mL Purge<br>17. Corrected MTCA RL for Methoxyclor & Manchester RL for all Pesticides<br>18. Updated MDL for Manchester Beta-BHC to reflect latest MDLV<br>19. Corrected Tissue Pesticide RLs<br>20. Updated MDLV for LVI-SIM-PNA in Water with Liq-Liq Extraction<br>21. Updated MDL for VOA-SIM Analysis of Aqueous Samples<br>22. Updated MDLV for PCB in Water (500 to 5 mL)<br>23. Updated MDLV for Diesel in Water (NWTPH-D & AK102)<br>24. Updated MDLV for Chlorophenols in Aqueous Samples<br>25. Updated MDLV for Chlorophenols in Tissue Samples<br>26. Removed & Archived Modifications to LQAP for 2002 & 2003<br>27. Updated MDL for Skydrol/BHT Analysis in Water Using 8270-SIM<br>28. Removed Direct Aqueous Injection MDLs RL Table.<br>29. Updated SOP Table (Appendix E) |
| 12-004 | 8/19/05 | 1. Added “A” Flag for GeoTech to Appendix N.<br>2. Updated MDL for JP-4 in Soil<br>3. Updated MDL for Pesticides in Tissue<br>4. Updated MDLV for JP-4 in Soil<br>5. Updated MDLV for Pesticides in Soil<br>6. Updated MDLV for Pesticides in Water<br>7. Updated MDLV for PCB in Soil (25g to 1 mL)<br>8. Updated MDLV for PCB in Water (500 to 5 mL)<br>9. Updated MDLV for TPH-D in Water<br>10. Updated MDLV for PNA-SIM in Water (Liq-Liq Extraction)<br>11. Updated MDLV for VOA in Water (5 mL 8260B)<br>12. Updated MDLV for VOA in Water (20 mL 8260B)<br>13. Updated MDL for PSDDA SVOA in Sediment<br>14. Updated Appendix E – SOP List<br>15. Corrected MDL for Pesticides in Soil Information (IA-80 not GU-32)<br>16. Corrected Reporting Limits for TBT in Water, Sediment & Tissue<br>17. Added Control Limits for 1,4-Dioxane to SVOA List<br>18. Added low level RLs for BTEX Compounds<br>19. Updated MDLV for TBT in Pore Water<br>20. Updated MDLV for BTEX Water & Soil<br>21. Updated MDLV for TPH-G in Water & Soil<br>22. Updated Appendix E SOP Table<br>23. Updared MDLV for Motor Oil in Soil Using ASE<br>24. Updared MDLV for Motor Oil in Soil Using MicroTip<br>25. Updared MDLV for Motor Oil in Water Using SepFunnel<br>26. Updared MDLV for JP-4 in Water Using SepFunnel |
| 12-003 | 7/15/05 | 1. Added MDLV for 5 mL VOA Analysis of Water – Method 8260B<br>2. Updated MDL for MTCA PCB in Water Samples<br>3. Added MDL for Soxhlet Extraction of PCBs<br>4. Removed Aroclor 1242 from MDL Table |

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| | | 5. Control Limits for HEM Changed to Equal Those in SOP 648S<br>6. Updated MDL for PSDDA PCB Analysis.<br>7. Added MDL for TBT in Tissue<br>8. Updated MDL for 20 mL 8260B<br>9. Updated MDLV for SIM-VOA<br>10. Updated MDL for Pesticides in Soil<br>11. Updated MDLV for TPH-D in Soil<br>12. Added MDLV for PSEP Level Pesticides in Sediment<br>13. Updated (added missing compounds) PSDDA SVOA MDLs<br>14. Updated & Corrected Appendix F (Containers & Preservatives)<br>15. Added "A" Flag for GeoTech to Appendix N. |
| 12-002 | 6/9/05 | 1. Updated Motor Oil MDL (NWTPH-Dext & AK103) for Soil<br>2. Documented MDLV for Gasoline in Soil (Methods NWTPH-G & AK101)<br>3. Corrected units for DRO & RRO MDL for water from mg/kg to mg/L<br>4. Added MDL for JP-4 in Water using Sep Funnel Extraction<br>5. Updated MDL for Sediment Analysis (Krone) of TBT using Sonication<br>6. Updated MDL for SVOA Water SepFunnel<br>7. Noted that BTEX –SIM MDL in Table was Medium Level Extraction<br>8. Added MDL Verification Information for ICP Metals<br>9. Updated MDL for TBT in Water and Pore Water – SepFunnel<br>10.Updated MDLV for TPH-D Water – SepFunnel<br>11. Added EPH and VPH RL Tables<br>12. Added MDLV for JP-4 Analysis of Water – Sep Funnel<br>13. Added MDLV for BTEX analysis of Soil<br>14. Added MDLV for SVOA Water - SepFunnel<br>15. Added MDLV for TBT Sediment<br>16. Updated MDL for PSEP Pesticides in Sediment/Soil<br>17. Updated MDL for Chlorinated Phenols in Water<br>18. Updated MDL for Pesticides in Water – SepFunnel<br>19. Added MDLV for 524.5<br>20. Added MDLV for Metals<br>21. Updated MDL for Manchester Pesticides<br>22. Added Appendices to the Table of Contents<br>23. Added MDL for PCB Analysis of Tissue |
| 12-001 | 4/5/05 | 1. List of SOPs (Appendix E) Modified & Updated as Appropriate<br>2. MDL Verification for DRO in Soil Added<br>3. MDL Verification for PCB Water Standard Analysis (HO-24) Added<br>4. AK-101 Removed from BTEX MDL Table for Water<br>5. Metals IDLs & MDLs Updated<br>6. BTEX MDL for Analysis of Water and Soil Updated<br>7. RL for 1,4-Dioxane in SVOA Analysis of Water Changed from 1.0 to 5.0<br>8. Control Limits for BTEX and Gasoline updated<br>9. MDL for Gasoline in Soil Updated<br>10.MDL for Diesel and Motor Oil in Soil Updated.<br>11. Split TPH-G Table into Aqueous and Soil Table & added MDLV for Water<br>12. Entered updated MDLs for SIM-LVI-PNA<br>13. Changed RL for 20 mL 1,2-Dibromo-3-Chloropropane from 2 to 0.5 ppb<br>14. Updated MDLs for 524.2<br>15. Updated Conventionals MDLs<br>16. Updated MDLs for 5 mL VOA analysis of Water Samples (8260B)<br>17. Modified MDL Table for TPH-D Analysis of Water<br>18. Updated TPH-D and TPH-Dext MDL for Water Analyses.<br>19. Removed EPH and VPH MDLs from the LQAP |
| 11-028 | 12/31/04 | 1. Modified definition of "Y" flag in Appendix N<br>2. Updated MDL for TPH-D Soil<br>3. Updated Appendix M - Laboratory Certification and Accreditation |
| 11-027 | 12/15/04 | 1. Updated SOP List in Appendix E. |

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| | | 2. Added AK-101 to BTEX/GRO Control Limit Table.<br>3. Lowered RL for Benzene in MDL Summary for Method 8021B<br>4. Added Additional Surrogates to VOA-SIM BTEX Control Limit Table<br>5. Corrected BTEX MDLs for 8260-SIM to Reflect Sample Conc. Not On-Column values<br>6. Updated SOP Table in Appendix E<br>7. Modified VOA 5 mL Water RLs - Acrylonitrile & 1,2,3-Trichloropropane<br>8. Modified VOA mL Soil RL – 4-Methyl-2-Pentanone<br>9. Corrected MDL Value for Methoxychlor in PSDDA Sediment Analysis.<br>10.Modified definition of "Y" Flag in Appendix N<br>11.Updated MDL for BTEX Water PID-2<br>12.Updated MDL for Pesticides MTCA Analysis of Water<br>13.Updated MDL for PSDDA SVOA Analysis<br>14.Updated MDL for VOA Soil<br>15.Updated MDL for SVOA, Water, Liq-Liq<br>16.Updated MDL for Various PCB (1660) Analyses<br>17.Updated MDL for TPH-G – Water & Soil<br>18.Updated MDL for SVOA Soil Micro Sonication<br>19.Added MDL for Manchester Aroclor 1254<br>20.Modified Control Limits for EPH Analyses<br>21.Deleted MDL Table for SVOA, Soil, MacroTIp Extraction<br>22.Deleted MDL for Soil Skydrol/BHT, GC-MS-SIM<br>23.Updated Instrumentation Listing (Appendix D) |
| 11-026 | 11/02/04 | 1. Updated Control Limits for SIM-PNA<br>2. Added Control Limit Table for Full Scan PNA Analysis (Method 8270D)<br>3. Updated SIM-PNA Water MDL for NT-1<br>4. Updated Appendix E – SOPs<br>5. Modified PCB MDL Table –Remove Manchester & Combine PSEP/Low Level Sediment MDLs<br>6. Updated MDL for VOA SIM Water NT3<br>7. Updated MDL Table for SIM Skydrol/BHT in Water<br>8. Updated SOP Table in Appendix E. |
| 11-025 | 9/16/04 | 1. Added new Appendix N listing Data Qualifiers & changed designations for Appendices N, O & P to O,P & Q respectively<br>2. Updated MDL Table for PCB Analyses.<br>3. Combined MDL tables for SVOA Water & Deleted Sep Funnel Table<br>4. Updated PCB & TPH-D MDL Tables<br>5. Updated Equipment List (Appendix D) & added GeoTech Equipment<br>6. Revised MDL Table for FID Analysis of Polar SVOA (EPA Method 8015)<br>7. Updated MDLs for Pesticide analysis of soil.<br>8. Sediment Pesticide MDLs added to Soil Table, Sediment Table Deleted<br>9. Control Limit for MS Recovery of Pyrene in Sediment Corrected<br>10.Updated Cyclohexanone MDL (Finn 1, 20 mL purge)<br>11.Updated SIM-PNA Soil MDL for NT-1<br>12. Edited MDL Tables for SVOA for consistency and accuracy<br>13. Modified EPH Reporting Limits<br>14. Revised formatting on most MDL tables.<br>15. Corrected dates for VOA Control Limit data<br>16. Deleted analytes except cyclohexanone from VOA MDL Table for Project Specific Analytes.<br>17. Added BTEX in Soil to VOA-SIM MDL Table<br>18. Added Manchester MDL to PCB Table<br>19. Updated Skydrol/BHT Control Limits |
| 11-024 | 7/19/04 | 1. Revised and Updated MDL Tables for TPH Analyses of Soil/Sediment.<br>2. Revised and Updated MDL Tables for PCB Analyses. Combined All PCB MDL into One Table.<br>3. Deleted all other MDL tables |

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| | | 4. Updated MDL for VOA analysis of Soil using ARI's In-house Method.<br>5. Added 1-Methylnaphthalene to SIM-PNA MDL Tables for Water & Soil<br>6. Updated Appendix D (Lab Equipment) and added GeoTech Section<br>7. Combined Water & Soil SIM-PNA MDL Tables into One Table<br>8. Deleted Water-SF & Soil SIM-PNA MDL Tables<br>9. Updated MDLs for Pesticide – Manchester Extraction<br>10. Revised VOA Water Control Limits Table<br>11. Updated MDLs for VOA analysis of Water-8260B-5mL purge |
| 11-023 | 7/6/04 | 1. Corrected Conventionals MDL/RL Table<br>2. Corrected Control Limit for TPH-D MS Recovery in Water Samples.<br>3. Updated MDLs for NWTPH-D Soil ASE & MicroTip.<br>4. Removed HPLC MDL Table for analysis of PNA.<br>5. Removed MDL Table for HCID<br>6. Removed FID-3B from TPH MDL Tables<br>7. Updated MDLs & Modified Table for SVOA-PSEP analysis of Sediments<br>8. Revised Section 11<br>9. Updated MDL for VOA (524.2) analysis of Water<br>10. Removed MDLs for VOA-SIM analysis of Soil<br>11. Updated MDL Table for VOA-Water 20 mL<br>12. Updated MDL Table for VOA-Water 5 mL |
| 11-022 | 5/17/04 | 1. Corrected Extract Final Volume in MDL table for Sediment PCB<br>2. Deleted FINN 8 from all MDL Tables<br>3. Corrected RL for Hg in Water. |
| 11-021 | 5/07/04 | 1. Implemented default control limits for EPA Method 524.2<br>2. Decreased RL for Aroclor 1221 to level of other Aroclors<br>3. Eliminated Control Limits for VOA using ARI SOP 804S.<br>4 Updated VOA 8260B full scan control limits for water & sediment/soil<br>5. Updated 10 mL purge VOA-SIM control limits for water<br>6. Changed effective date for VOA-SIM BTEX control limits<br>7. Updated 8270-SIM-PNA control limits for water & sediment/soil<br>8. Updated BTS control limits for water & soil. |
| 11-020 | 4/26/04 | 1. Updated MDL (PID1 & 2) for BTEX in water<br>2. Updated MDL (PID 1) for gasoline in water<br>3. Deleted MDL Table for ASE extraction of chlorinated pesticides<br>4. Updated MDL for VOA water 5 mL purge 8260B on NT3<br>5. Updated MDL for pesticide in water separatory funnel on ECD3<br>6. Added MDL Table for VPH in water and soil<br>7. Deleted Control Limit Table for HPLC PNA<br>8. Updated PCB control limits<br>9. Updated Herbicide control limits<br>10. RL for Sulfate to 2.0 & 20.0 ppm for water & solids respectively<br>11. Updated TPH-D Control Limits<br>12. Updated Chlorinated Phenols Control Limits<br>13. Updated BTEX & TPH-G Control Limits<br>14. Corrected Pesticide MTCA MDL Table<br>15. Corrected RL for GC-ECD analyses of HCBD & HCB |
| 11-019 | 3/11/04 | 1. Revised holding time for Total Solids in soil & sediment from 7 days to 14 days.<br>2. Updated MDLs for SVOA water L/L NT4 & NT 6.<br>3. Updated Metals IDLs and MDLs<br>4. Added QA Policy 9 – Modifications to method, protocol or reports<br>5. Updated Conventionals MDLs<br>6. Added QA Policy 10 – Reporting of dual column GC analytes |
| 11-018 | 1/21/04 | 1. Revised Control Limits for GC-MS analysis of SVOA<br>2. Revised Control Limits for Chlorinated pesticides<br>3. Updated Appendix E – Table of SOPs<br>4. Updated and Revised Appendix F – Sample Containers, Preservation and |

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| | | Holding Times<br>5. Modified Sign-of Sheet to include only QA manager |
| 11-017 | 1/4/04 | 1. Minor revisions to Section 13<br>2. Revisions to subcontracting language in Section 6.3 |

# APPENDIX C
# TEST AMERICA QUALITY ASSURANCE MANUAL

# Quality Assurance Manual

TestAmerica
ANALYTICAL TESTING CORPORATION

***Seattle Division***

11720 North Creek Parkway North, Suite 400
Bothell, WA 98011-8223
425-420-9200

***Effective Date of Revision 14.3: August 21, 2006***

Prepared By:

TestAmerica Analytical Testing Corp – *Seattle* Division

Heather L Bean 8/17/06
Heather Bean Date
Laboratory Director
Acting Organics Technical Director

David A Wunderlich 8/17/06
Dave Wunderlich Date
Quality Assurance Manager

Lynne M. Cox 8/17/06
Lynne Cox Date
Microbiolgy/Conventionals Technical Director

Anthony Ocana 8/17/06
Anthony Ocana Date
Trace Metals Technical Director

These signatures document that the Laboratory Director and Quality Assurance Manager approve the contents of this manual and are committed to provide the resources necessary to ensure the quality of results reported by this laboratory.

# Table of Contents

## Figures



## Appendices

# Quality Assurance Manual, Revision 14.3
# Internal Distribution List

Controlled copies of the QAM are distributed on the date issued to the "laboratory's approved signatories"; individuals listed below in Part A. The signature requirement of each ensures that each controlled copy will be updated with current revisions. Controlled copies of the QAM are also distributed to responsible positions in each department of the laboratory in order to provide access to all personnel. Applicable positions and corresponding departments are listed below in Part B. The QA Manager will be responsible for distributing copies of the QAM to the applicable positions and keeping an on-going distribution list for controlled copies of the QAM.

***Part A - Individual Distribution:***

| | |
|---|---|
| *Heather Bean* | *Laboratory Director* |
| Dave Wunderlich | Quality Assurance Manager |

***Part B - Position / Departmental Distribution:***

Project Manager(s) / Client Services / Sales
Office Manager / Administration
Sample Control Officer / Sample Receiving & Support
Inorganic Manager / Metals
Microbiology Supervisor / Microbiology
Organics Manager / Organics
Extractions Supervisor / Organic Extractions

# *1.0 INTRODUCTION AND POLICY STATEMENTS*

## *1.1 Introduction and Compliance References*

TestAmerica-Seattle (TA-S) provides chemical, microbiological and physical testing services for government, industrial, and private entities, including the Department of Defense, State regulatory agencies, Ports, Utilities, Transportation, Oil companies and their consultants. The TA-S Quality Assurance Manual (QAM) outlines the standard policies, responsibilities and procedures that are the foundation of laboratory operations; allowing TA-S a basis on which to build and meet the specifications of the individual projects and programs.

In addition, this document has been prepared to assure compliance with the 2003 National Environmental Laboratory Accreditation Conference (NELAC) and ISO/IEC 17025 (2005) standards.

## *1.2 Quality Assurance Policy Statement*

The TA-S QAM is a set of policies and procedures designed to ensure that the data produced by the laboratory consistently conforms to the applicable quality standards set by state and federal regulations. The management of TA-S is committed to compliance with applicable state and federal regulations, as well as with the 2003 National Environmental Laboratory Accreditation Conference (NELAC) and ISO/IEC 17025 (2005) standards. The quality system functions at the management level through company objectives and management policies. It functions at the analytical level through standard operating procedures and quality control practices. The two levels are spanned by the functions of the Quality Assurance department. The result is data of known and documented quality that is accurate, reproducible and legally defensible.

### 1.2.1 Scope

TA-S requires the application of sound QA/QC principles to all aspects of data generation. This QA Manual documents an integrated system of policies for all phases of laboratory operation including procurement of supplies, sample handling, sample analysis, data acquisition, report preparation and report review.

Every staff member at TA-S plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is therefore required that all laboratory personnel read, review, understand and agree to comply with the procedures and requirements established by this document.

### 1.2.2 Purpose

The TA-S QA System, documented as the QA Manual, is designed to control and monitor the quality of the data generated in the laboratory.

### 1.2.3 Goals

The TA-S QA System has been established to support the following corporate goals:

(1) Ensure that all services provided meet or exceed industry standards for quality assurance.

(2) Operate in a manner that supports our corporate philosophy:

"To provide to our clients a broad range of environmental testing services at a fair price delivered with data quality, turnaround time, and client service that consistently meet or exceed expectations."

The TA-S QA System operates within this framework of corporate goals to achieve the following specific quality objectives:

(a) Provide effective guidance for verifying compliance with quality and reliability standards.
(b) Provide a mechanism to continually monitor the use and effectiveness of the QA System.
(c) Provide a mechanism for recommending improvements in all areas of TA-S operations where quality may be affected.
(d) Provide a system of analytical quality control that will allow the end user to confidently assess the quality of the analytical data.
(e) Strive to ensure comparability of data through standardization of policies, procedures and methodology throughout the northwest network of TestAmerica laboratories.
(f) Ensure that the methodologies selected for a project will yield results that are representative of the parameters to be measured and that the sample handling techniques selected for an analysis will yield results representative of that matrix.
(g) Ensure that the analytical practices employed for a project will yield a sufficient quantity of results which are useable for the intended purposes of the analytical data.

## *1.3 Policy on Review of QA Manual and Quality System*

1.3.1 QA Manual Review

The Technical Directors and Quality Assurance Manager review the QA Manual on an annual basis. All changes to existing QA policy are discussed at this time. All revisions, additions or deletions to policy are authorized by TA-S management via publication of a revision to the QA Manual, which is signed by Management.

1.3.2 QA System Review

The QA Manager continually assesses the efficacy of the TA-S Quality System and notifies laboratory management, as needed, of corrective actions warranting recommendation for procedure or policy changes. Laboratory management conduct reviews of their Quality Systems and testing activities annually to ensure suitability and effectiveness and to introduce any necessary changes or improvements in the Systems and laboratory operations. Management's conclusions and goals are summarized in report to the QA Manager.

## *1.4 Policy on Ethics and Data Integrity*

TA-S, as a member of the American Council of Independent Laboratories (ACIL), participates in the ACIL Seal of Excellence Laboratory Program. Participation in this program requires that the laboratory comply with the Council's Data Integrity Initiative. To meet this objective, TA-S developed and implemented a Data Integrity Program. Elements of the program include an Ethics Policy and Code of Ethical Conduct (Figure 1), a corresponding Ethical Conduct Agreement (Figure 2), an Ethics and Compliance Officer, written procedures, a confidential mechanism for reporting alleged misconduct, surveillance, enforcement, and employee training. Ethics training is presented to each new employee within the first thirty days of employment and retraining of the entire staff is conducted annually.

### *1.5 Policy on Confidentiality of Information*

It is the responsibility of all TA-S employees to safeguard sensitive client and company information, including (but not limited to) analytical, financial, marketing, and operating information. Analysis information and results will be released only to the client or to other parties after receipt of written authorization from the client. The nature of our business and the economic well being of TA-S is dependent upon protecting and maintaining client confidentiality, as well as proprietary information.

### *1.6 Policy for Exceptionally Permitting Departures from Documented Policies, Procedures or Contractual Specifications*

Departures, exceptions or deviations from documented policies, procedures or contractual specifications are not permitted without approval by the Laboratory Director, Technical Director, or QA Manager, and where applicable, require written permission of the client for whom the data is intended. In order to expedite sample analysis, permission may be confirmed in an email. A copy of the correspondence is retained in the client or work order file.

## *2.0 ORGANIZATION, RESPONSIBILITIES & AUTHORITIES*

### *2.1 Organization*

2.1.1 Organization Objectives

TA-S is organized in such a manner as to:

(a) ensure that, in accordance with it's Ethics Policy, Code of Ethical Conduct and Ethical Conduct Agreement and ACIL's Code of Ethics, all personnel are free from any commercial, financial or any other undue pressures which might adversely affect their work.

(b) maintain independence of judgment and avoid conflict of interest. For example, the QA staff must have functions independent from the laboratory operations for which they have QA oversight.

(c) ensure that all work is conducted by persons who are adequately trained and supervised.

2.1.2 Organizational Charts

The TA corporate structure is depicted as Figure 3.0. The organizational chart for TA-S, depicted in Figure 3.1, documents the relationship between management, technical operations and support services. Respective responsibilities of key positions to the laboratory's quality system are outlined in Section 2.2. The QA lines of authority are depicted as Figure 4.

### *2.2 Responsibilities of Key Personnel*

The following are brief descriptions of the administrative and QA responsibilities for personnel. Detailed job descriptions, including minimum educational and technical qualifications for each position, are kept by the Human Resources Manager and/or Laboratory Director. Minimum requirements for all assumed roles must be achieved.

*2.2.1 Chief Operating Officer (COO)*

*The COO serves as the ranking executive for all respective company operational functions and reports to the CEO of the corporation. The COO has full responsibility for the overall administrative and operational management of company operational functions. The COO participates with the CEO and the Board of Directors in formulating strategic direction for the company, being specifically accountable for the Laboratory Division. He ensures the attainment of corporate objectives through the selection, development, motivation, and evaluation of top management personnel. The COO approves all operating budgets and capital expenditures and participates in the selection and approval of banking, legal, and accounting relationships.*

*2.2.2 Executive Vice President of Western Operations (EVP)*

*The EVP reports directly to the COO and has full responsibility for the overall administrative and operational management of their respective laboratories. The Vice President of Operations provides each member of the management team with sufficient authority and resources to comply with the TA QA Program. Duties of this position include:*

*(a) selecting, promoting and directing senior management staff,*
*(b) delegating authority for major operational functions,*
*(c) overseeing control of financial responsibilities,*
*(d) reviewing and approving the Corporate QAM template used by each laboratory to prepare a laboratory-specific QAM,*
*(e) serving as the final authority regarding operational decisions, interpretation of analytical methods and resolution of disagreements regarding QA policies and*
*(f) restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.*

*2.2.3 Vice President – Quality Assurance (VP-QA)*

*The Vice-President of Quality Assurance reports directly to the CEO. With the aid of the EVPs, VPs, Laboratory Director/Managers, Quality Assurance Director and laboratory Quality Assurance Managers, the VP-QA has the responsibility for the establishment, general overview and Corporate maintenance of the quality assurance program within TestAmerica Analytical Testing Corp. Additional responsibilities of the VP of QA include:*

*(a) Reviewing the QA/QC aspects of corporate SOPs, national projects and expansions or changes in services,*
*(b) coordinating/preparing the corporate QAM Template that is used by each laboratory to prepare its own laboratory-specific QAM,*
*(c) with the assistance of the Corporate QA Director, overseeing the QA/QC programs within each laboratory (this includes a final review of each laboratory-specific QAM and receipt of each laboratory's QA monthly report),*
*(d) participating, as needed, in the hiring of laboratory Quality Assurance staff,*
*(e) maintaining corporate Quality Policy memorandums and corporate SOPs,*
*(f) maintaining data investigation records that are reported to Corporate management,*
*(g) assisting with certification activities,*
*(h) work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings and*
*(i) With the assistance of the Health and Safety Director, develop and implement the TestAmerica Safety and Chemical Hygiene Program.*

*2.2.4 Quality Assurance Director (Corporate)*

*The Quality Assurance Director (QAD) reports to the VP-QA and may report data integrity issues directly to the CEO as needed. Together with the VP-QA, the QAD has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance program within TestAmerica Analytical Testing Corp.*

2.2.5 Ethics and Compliance Officer (ECO)

*TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – one to work primarily with the eastern locations (Vice President of Quality Assurance) and the other to work primarily with the western locations (Director of Quality Assurance). Each ECO acts as a back-up to the other ECO and both are involved in data investigations. The Vice President of Quality Assurance/ECO reports to the CEO and has a direct line of communication to the entire senior Corporate and lab management staff. The Director of Quality Assurance may report violations to the CEO or the Vice President of Quality Assurance and has a direct line of communication to the entire senior Corporate and lab management staff. Responsibilities of the ECO include:*

*a) ensuring that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies*
*b) establishing a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment,*
*c) monitoring and auditing to determine compliance with policies and to make recommendations for policy enhancements to the CEO, Laboratory Director/Manager or other appropriate individuals within the laboratory,*
*d) assisting the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function and*
*e) participating in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.*

*2.2.6 Health and Safety Director (HSD) (Corporate)*

*The Health and Safety Director reports directly to the VP-QA. The Health and Safety Director is responsible for the development and implementation of the TestAmerica Safety and Chemical Hygiene program. Responsibilities include:*

*a) Consolidating and tracking all safety and health-related information and reports for the company, and managing compliance activities for TestAmerica locations,*
*b) Coordinating/preparing the corporate Safety Manual / Chemical Hygiene Plan (CHP) Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP,*
*c) Preparing information and training materials for laboratory Safety Officers,*
*d) Assisting in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations,*
*e) Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management and*
*f) Serving as Hazardous Waste Management main contact and providing technical assistance to location management.*

2.2.7 Laboratory Director

*The Laboratory Director is responsible for the overall quality, financial, technical, human resource and service performance of the whole laboratory and reports to the EVP-Western Division. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive quality assurance and data integrity program. This senior operational management position within each laboratory is responsible directly, or by delegation, for the following:*

*(a) Providing one or more technical directors for the appropriate fields of testing. The name(s) of the Technical Director will be included in the national database. If the Technical Director is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Director to temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary accrediting authority must be notified in writing,*

*(b) ensuring that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented,*

*(c) ensuring that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work,*

*(d) ensuring TestAmerica's human resource policies are adhered to and maintained*

*(e) ensuring that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory,*

*(f) ensuring the availability of functional equipment and efficient operating systems,*

*(g) ensuring that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits,*

*(h) restricting the laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual*

*(i) reviewing and approving all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to*

*(j) Pursuing and maintaining appropriate laboratory certification and contract approvals (supports ISO 17025 requirements),*

*(k) ensuring client specific reporting and quality control requirements are met*

*(l) captaining the management team, consisting of the QA Manager, the Technical Directors and department managers/supervisors as direct reports*

*(m) administrative and technical oversight of all data generation and reporting functions and client services,*

*(n) managing material and labor including allocating and hiring technical staff, project scheduling, prioritizing work, production labor, overtime, oversight of laboratory supply purchases and promotion or discipline of operational staff,*

*(o) coordinating with the QA/Technical Directors to ensure timely implementation of QA corrective actions and to resolve any complaints or critical quality issues which might result in interruption of analytical production and*

*(p) maintaining a proactive program for detecting and preventing improper, unethical or illegal actions associated with the laboratory's operation.*

2.2.8 Technical Director

The Technical Directors report directly to the Laboratory Director. *They are accountable for all analyses and analysts with respect to ISO 17025. The scope of responsibility ranges from the new-hire process and*

*existing technology through the ongoing training and development programs for existing analysts and second- and third-generation instrumentation.* The Technical Director also has indirect reporting authority to the EVP on issues affecting laboratory data quality. Specific responsibilities include, but are not limited to:

*(a) Coordinating, writing, and reviewing preparation of all test methods (i.e., Standard Operating Procedures) with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples,*

*(b) ensuring that the SOPs are properly managed and adhered to at the bench,*

*(c) reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts,*

*(d) monitoring the validity of the analyses performed and data generated in the laboratory by reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems*

*(e) providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis (training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance),*

*(f) enhancing efficiency and improving quality through technical advances and improved LIMS utilization.*

*(g) forecasting capital and instrument life cycle planning for second generation methods and instruments as well as asset inventory management,*

*(h) scheduling all QA/QC-related requirements for compliance (e.g., MDLs, etc),*

*(i) captaining department supervisors to communicate quality, technical, personnel, and instrumental issues for a consistent team approach,*

*(j) coordinating audit responses and client complaint investigations with supervisors and QA Manager,*

(k) developing new analytical capabilities and answering technical inquiries from clients, project managers and marketing personnel and

(l) communicating quality issues to the *Vice President of Operations* and Laboratory Director.

(m) *with the knowledge and approval of the Laboratory Director, restricting the laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.*

2.2.9 Quality Assurance Manager

*The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system based on ISO 17025 and assessing the overall effectiveness of the quality system. The QA Manager reports directly to the Laboratory Director and has access to Corporate QA for advice and resources. This position is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA officers to accomplish specific responsibilities, which include, but are not limited to:*

*(a) Having functions independent from laboratory operations for which he/she has quality assurance oversight,*
*(b) maintaining and updating the QAM and quality assurance/quality control SOPs,*
(c) monitoring and evaluating laboratory certifications,
(d) scheduling proficiency testing samples,
*(e) monitoring and communicating regulatory changes that may affect the laboratory to management,*
*(f) training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities,*
*(g)* ensuring the implementation of quality control procedures,
*(h) having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed),*
*(i) arranging for or conducting internal audits on quality systems and the technical operation,*
*(j) maintaining records of all ethics-related training, including the type and proof of attendance,*
*(k) coordinating document control of SOPs, MDLs, control limits, and miscellaneous forms and information,*
*(l) monitoring standards of performance in quality control and quality assurance,*
(m) evaluating non-conformance reports,
*(n) reviewing a percentage of all final data reports to ensure internal consistency, sensibility and completeness of the project file contents.*
*(o) notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken,*
*(p) with the knowledge and approval of the Laboratory Director, restricting the laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual,*
*(q) preparing various quality reports for the Laboratory Director, clients and/or Corporate QA and*
*(r) captaining the QA team to enable communication and to distribute duties and responsibilities.*

2.2.10 Project Manager

Project Managers are responsible for direct interaction with clients to ensure that clients' needs are met and for negotiating appropriate priorities for analytical work. Duties include:

(a) project planning and set-up,
(b) review of contracts and sample log-ins,
(c) project tracking,
(d) ensure that the requirements of TA-S policies and any applicable contractual specifications have been met for the project,
(e) final review of all reports, including QC, for completeness and representativeness,
(f) generate and sign the final report.

2.2.11 Department Manager/Analytical Supervisor

The Department Manager/Supervisor oversees the activities of a particular department to ensure that adequate personnel, equipment, time and other company resources are available and properly allocated to successfully accomplish the analytical requirements of projects within the department. Responsibilities of the position include:

(a) ensuring adequate peer and/or supervisory review of all results, including QC data, before submission to Project Managers,
(b) assure that the proper level of analytical QC is being carried out by the analyst and that all QC and other data impacting the analysis are properly documented,
(c) direct QA activities, such as the updating of SOPs and completion of MDL studies.

2.2.12 Environmental Health and Safety Officer

The Environmental Health and Safety (EHS) Officer is responsible for facilitating continuous improvement to laboratory health and safety by development and implementation of a Health and Safety Plan. The EHS Officer also ensures TA-S's compliance with hazardous waste disposal regulations by development and implementation of a Hazardous Waste Management Program.

2.2.13 Sample Management Personnel

Sample Management personnel are responsible for receiving and logging-in samples delivered to TA-S including:

(a) record the condition of the samples, ensure that samples are preserved properly, delivered in appropriate containers and are present in sufficient quantity for analysis,
(b) maintain a chain of custody, assign laboratory numbers, enter sample work order information into the laboratory information system,
(c) ensure samples are stored properly,
(d) immediately notify the project manager and/or client of any anomalies with sample receipt and/or log-in.

2.2.14 Analyst/Technician

As the primary staff member position, an Analyst/Technician is responsible for all steps in their assigned analytical procedures. Analysts/Technicians are the front line for quality in the laboratory and bear primary responsibility for producing defensible data. Analyst/Technician duties include:

(a) overseeing sample preservation and preparation, performing analysis, and recording all pertinent analytical data,
(b) performing procedures consistent with the guidelines specified in the TA-S QA Program, all pertinent SOPs and the published analytical reference procedures,
(c) conducting routine maintenance of equipment and document acceptable performance of instrumentation with respect to the requirements of their analytical procedures,
(d) performing, evaluating and documenting the specific QC measures stated in the QA Program and SOPs,
(e) Conducting and documenting primary review of their analytical data prior to release of the data to peers, supervisors, or managers for secondary review.
(f) Reporting out-of-control data or events to the Department Manager, Supervisor and/or QA Manager.

### *2.3 Deputies*

In the case of the absence of one of the following key personnel, the corresponding position noted would be considered the deputy:

| | | |
|---|---|---|
| *(a) E.V.P. Western Div* | - | *Chief operating Officer* |
| (b) Laboratory Director | - | Technical Director |
| (c) Environmental H & S Officer | - | Laboratory Director |
| (d) Technical Director | - | *Laboratory Director* |
| (e) QA Manager | - | *Laboratory Director* |
| *(f) Ethics and Compliance Officer* | - | *VP-QA or QAD* |

### *2.4 General Responsibilities*

All laboratory personnel involved in the generation and reporting of data have a responsibility to read and understand the TA-S QA Manual. The responsibilities of all laboratory personnel include:

(a) Ensuring that all work generated by them, or for which they are responsible, is in compliance with the TA-S QA Manual.
(b) Performing all work according to approved written SOPs based on the most current promulgated method; or, in the absence of an approved SOP, other applicable protocols or methods.
(c) Ensuring that all records related to their work are complete and accurate.
(c) Documenting and providing immediate notification of any quality problems to the QA Manager or other appropriate management personnel.

Laboratory personnel have the authority to accept or reject data based upon compliance with defined QA criteria and/or professional judgment. Department managers must approve the acceptance or rejection of data that falls outside of established QC guidelines. This authority is in accordance with the guidelines established in the TA-S QA Manual.

Any effort to influence laboratory personnel, either internally or externally, through undue pressure, commercial representations, financial obligations, or any other such action is strictly prohibited. Any staff member who believes or interprets that such action has been taken must immediately report this activity to the Laboratory Director, Technical Director, and/or QA Manager.

## *3.0 ACCREDITATIONS, CERTIFICATIONS AND AFFILIATIONS*

TA-S holds accreditations/certifications from various government agencies and private organizations. The accreditations and certifications, along with the full scope of parameters, are presented in the appendix of this document. The laboratory maintains their accreditations/certifications by (1) compliance with the relevant standards of operation, (2) submission of acceptable performance evaluation test results and (3) undergoing periodic external audits by the accrediting authority. Project Managers work in conjunction with the QA staff to ensure that appropriate certifications are held so that all reported analytical data complies with the clients' regulatory requirements.

# *4.0 PROFESSIONAL STAFF*

## *4.1 Qualifications*

TA-S ensures that key personnel meet the experience and educational requirements specified by the applicable programs under which work is conducted by stipulating qualifications for all positions and through continuous training of technical staff. The Laboratory Director and Technical Director are responsible for ensuring that the laboratory has sufficient qualified personnel to meet the demands of the workload.

## *4.2 Training*

4.2.1 Orientation

When reporting for work for the first time, all new employees at TA-S receive a copy of the documents listed below:

*(a)* *Employee Policy Manual*: contains information on the company's history and goals, administrative scheduling, benefits, and general administrative policies.

*(b)* *Health and Safety Manual* (which includes the *Chemical Hygiene Plan*): contains preventative procedures to avoid emergencies, as well as procedures for coping with emergencies such as spills, injuries, and fire. The *Chemical Hygiene Plan* contains pertinent information about the chemicals to which employees may be exposed and how to properly handle those chemicals.

*(c)* *TA-S QA Manual* (to read and return): A controlled copy of the QA Program is available to all staff members within their respective departments. Administrative or support staff may be directed to read only specific sections pertaining to their duties. The QAM contains information on the laboratory's quality assurance goals and objectives as well as how those goals are implemented in the laboratory.

*(d)* *Ethics and Data Integrity Agreement:* These guides are each new employee's reference Materials. Each new employee must read and understand the contents of these guides and sign a document agreeing to adhere to the requirements prescribed in the manuals, prior to any further training. These records are kept on file with the Human Resources Manager.

4.2.2 Departmental Operation Training

(a) In each operational area, laboratory method manuals are maintained that include copies of the procedures for which an analyst may be held responsible. These manuals include relevant quality control documentation, standard operating procedures, and procedures for trouble-shooting or corrective action. The analyst/technician must read and understand the contents of the method manuals. The analyst/technician must also be able to answer questions, demonstrating an understanding of the applicable methods.

(b) A Department Manager, Analytical Supervisor or other experienced analyst/technician is responsible for familiarizing new analysts/technicians with the instrumentation or techniques involved in their procedures. This includes covering items such as:

- Review of instrument manuals
- Preventive maintenance procedures
- Troubleshooting techniques
- Calibration requirements
- Documentation practices
- Data archiving procedures
- Maintenance logbooks
- Instrument history
- Hands-on operation of the instrument

4.2.3 Demonstration of Proficiency

The final level of training in every operational department requires a Demonstration of Capability (DOC) and shall be completed prior to analysis of samples. This demonstration may include analysis of proficiency testing (PT) samples, performance of a method validation study, method detection limit study or redundant analysis of client samples. *At TA-S, work cells are only relevant to trace metals and extractable organics. In both of these areas, the work cells are clearly delineated as a prep cell and an analysis cell. An employee assigned to the prep cell is expected to perform all steps of the prep from sample homogenization to final volume adjustment, including any cleanup procedures, if applicable. Similarly, an employee assigned to the analysis cell is expected to perform all steps of the analysis from vialing to data reduction. An employee assigned to one of these cells will demonstrate capability by completing all of the steps associated with the process.* Upon satisfactory completion of this phase, the analyst/technician performs analysis on client samples without oversight by another trained analyst/technician. If the analyst/technician does not meet these requirements he/she continues to work with the experienced analyst/technician until performance requirements are passed successfully.

4.2.4 Training Records

(a) Records of training are maintained through a cooperative effort of each technical employee, their immediate supervisor and the QA Manager, but are the responsibility of the QA Manager.
(b) Training files will be maintained for each technical staff member in the facility (sample control personnel, analysts/technicians, project managers, operational managers, etc.)
(c) Various forms may be used within the laboratory departments to document on-going training and proficiency. At a minimum, all training forms should include:
    - Personnel name
    - Training title/type or method name
    - Date(s) of training
    - Supervisor acknowledgment
    - Expiration, retraining or re-certification period for the training (if applicable)
(d) Training files should contain:
    - Documentation of the employee's agreement and ability to perform the most recent version of any analytical test methods for which they are responsible
    - Continued acceptable proficiency test results
    - Documentation of training courses or workshops on specific instrumentation, analytical techniques, etc.

## *5.0 MATERIALS, EQUIPMENT AND FACILITIES*

### *5.1 Facility Descriptions and Floor Plans*

5.1.1 Facility Design

(a) The facility was designed by chemists and constructed to meet the specific needs of a modern environmental chemistry laboratory. The building features separate areas for sample receiving, preparation, organic Gas Chromatograph (GC) analyses, organic Gas Chromatograph/Mass Spectroscopy (GC/MS) analyses, inorganic analyses, microbiological analysis, and administrative functions. Ample space has been provided for refrigerated storage of samples before analysis and archival storage of samples after analysis.

(b) The laboratory was designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for our employees. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation, access and safety equipment are met or exceeded. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

(c) Monitoring systems are in place to ensure proper operation. These systems include but are not limited to:
   (1) monitoring of turnaround time,
   (2) review of sample weekly/monthly sample volume,
   (3) health/safety reports,
   (4) quality assurance reports, and
   (5) FTE calculations.

A floor plan detailing location of fume hoods, bench space and instrumentation is provided in Figure 5.

5.1.2 Facility Security

TA-S is operated as a secure facility and all personnel receive general security training as provided in the *Security Policy for Hazardous Materials*. Sample receiving and reception entrances are staffed to screen visitors and visitor logbooks are maintained. Laboratory, office and storage areas are restricted. Visitors must be accompanied by a TA-S employee at all times while in the facility.

## *5.2 Capital Equipment and Maintenance*

5.2.1 Equipment

TA-S is continually upgrading and expanding its instrumentation capabilities. Instrumentation is purchased with regard to the applicable method performance criteria and all instrumentation utilized is in accordance with the relevant methods and SOPs. Records for all analytical equipment are maintained and include: equipment type, manufacturer and model number. An instrumentation list is provided in the appendix of this document.

5.2.2 Maintenance

Equipment is kept in proper working order through scheduled maintenance.

(a) Routine Maintenance

Routine maintenance schedules and required spare parts lists are in each specific analytical area. An example of routine maintenance for gas chromatographs might include changing injection liners, replacing septa, recharging gas line filters, and following manufacturer's procedures for cleaning detectors. It is the responsibility of the instrument operator to ensure that preventative maintenance concerns are routinely addressed.

(b) Non-Routine Maintenance

The expertise of department managers is sufficient for most non-routine maintenance and repair of the instrumentation within their department. The department manager, in conjunction with the technical director, is responsible for authorizing outside services for non-routine maintenance or repair of instrumentation. Technical support and services that meet regulatory requirements, such as A2LA Calibration Accreditation Policy – ISO/IEC Guide 17025, and/or manufacturer approvals are utilized for non-routine maintenance.

5.2.3 Logbooks

All instruments have logbooks in which operating conditions, adjustments, routine and non-routine maintenance, and any repairs are recorded. Each entry in the instrument logbook includes the date, the analyst, an adequate description of the problem, an adequate explanation of the solution and a verification that the instrument is functioning properly.

5.2.4 Identification

(a) Each piece of equipment that generates data must be labeled with a unique identification. Raw data can then be traced to the instrument from which it was generated. The unique identification of an instrument should also be noted in the instrument logbook.
(b) Any instrument or piece of equipment that has been shown to be defective, in that data generated by it consistently does not meet quality standards, shall be taken out of service and clearly identified as such.
(c) Calibration of instrumentation is maintained such that the instrument remains in an operative state or performed prior to commencement of analysis. Calibration status is therefore not designated on an instrument. Raw data supporting instrument calibration is retained in the respective department.

### *5.3 Purchasing of Materials*

Materials for use in the analytical process must meet applicable guidelines. This includes all gases used in gas chromatography, stock standards, all solvents, acids, and bases used in extraction or digestion, dilution, and standard preparation, and any other routinely restocked items. Upon receipt of any of items for which it is applicable, the lot number from the manufacturer is recorded and the purity of the lot established through a method blank and/or a calibration check. Specific detail of documentation requirements for reference standards is covered in the applicable section of this document. Routinely restocked items are purchased from qualified suppliers.

## *6.0 SUBCONTRACTING*

### *6.1 Requirements for Subcontracted Facility*

(a) When subcontracting analytical services, TA-S will assure to the extent necessary that the subcontract laboratory maintains a QA Program consistent with the requirements of this document, the requirements specified in ISO/IEC 17025 and/or the client's Quality Assurance Project Plan (QAPP).
(b) Work will only be subcontracted to laboratories holding current approval status with the accrediting body under which the work is being conducted.
(c) When possible, subcontract work from TA-S will be performed in other TA facilities.

### *6.2 Evaluation and Responsibilities*

(a) The QA Manager is responsible for evaluating the subcontractor's QA Program and accreditations and retaining current documentation of the evaluation. Subcontractor evaluation may or may not include an on-site audit. At a minimum, the subcontractor's accreditations and a copy of their QA manual will be reviewed and kept on file.
(b) The Project Manager is as responsible to the client for subcontracted data as they are for data generated by their own facility. The project manager should monitor the status of the analyses and communicate with the subcontract laboratory to facilitate the successful execution of the work and ensure the timeliness and completeness of the analytical report.

(c) A Project Manager may ship samples to a subcontract laboratory at any point after approval of the sample receipt documentation. The sample control department bears responsibility for ensuring compliance with applicable shipping regulations and QA requirements when shipping samples to a subcontract laboratory.
(d) Raw data for subcontracted work will only be retained at the subcontract facility, except in cases were a data package is requested for the project.
(e) If work subcontracted between TA facilities requires a data package, the subcontracted facility may be requested to provide the data as a complete package to be appended to that of the originating TA laboratory.

### *6.3 Notification*

(a) TA-S will notify the client in writing (e-mails acceptable) of the intent to subcontract any part of their requested analytical testing and when appropriate, gain the approval of the client, preferably in writing. Client notification will be documented and maintained with the appropriate work order.
(b) The Project manager is responsible for notification and documentation.
(c) Data reported from analyses performed by a subcontractor laboratory will be clearly identified as such on the analytical report provided to the client.

## *7.0 SAMPLING PROCEDURES*

The generation of quality data begins with the collection of the sample, and therefore the integrity of the sample collection process is of concern to the laboratory. Written sample collection procedures are available for clients who are performing sampling for drinking water testing. Sample collection guidelines, appropriate containers, preservatives and volumes required for analyzing routine parameters are included in the appendices of this document. In order to help ensure sample integrity, the following points, while outside of normal analytical laboratory operations, are included in the QA Manual:

(a) Samples must be collected in appropriate containers. In general, pre-cleaned and certified glass containers are used for organic parameters, and pre-cleaned and certified polyethylene containers are used for inorganic/metals parameters.
(b) Sample containers must be properly cleaned to eliminate one potential source of contamination that could occur during the collection process.
(c) Samples must be preserved and/or collected appropriately to minimize the loss of compounds of interest due to adsorption, volatilization, chemical degradation, or biological degradation.
(d) Appropriate volumes of sample must be collected to ensure that the required reporting limits can be met and that the required quality control frequency can be analyzed.
(e) Samples must be properly shipped to the laboratory in the appropriate time frame to ensure that temperature and holding time requirements can be achieved.

### *7.1 Holding Times*

The U.S. EPA has established holding time requirements for various analyses. These holding time requirements are listed in the documented appendix of this document. As indicated, holding time requirements differ depending upon the applicable regulatory program. TA-S follows the holding times given in SW-846 unless otherwise stipulated by methodology or regulatory authority or project-specific QAPP.

# *8.0 WORK PLAN REVIEW AND SAMPLE MANAGEMENT*

## *8.1 Objectives*

Prior to the commencement of work, TA-S will request that the client provide significant project details so that facilities and resources may be properly evaluated before commencing such work. TA-S's sample management system receives, tracks, preserves, stores, and disposes of samples under controlled conditions. Controls for sample receipt and custody are established by applicable protocols as documented in SW-846, and/or other governing regulations such as NELAC. SOPs document work plan review, sample handling procedures, and performance guidelines.

## *8.2 Work Plan Review*

Prior to receiving samples associated with a contract or bid, the TA-S project manager reviews the project-specific requirements found in these documents or the project's QA Plan or Sampling and Analysis Plan. The project manager assesses the laboratory's ability to meet these requirements. If conflicts exist, they are resolved to the client's satisfaction before the receipt of any samples. If samples are submitted without project-specific requirements, TA-S will default to standard TA-S method analyte lists, reporting limits and control limits.

## *8.3 Sample Receipt*

A sample acceptance policy is outlined in the Sample Control SOP. Upon receipt, the Sample Control Department Manager (or designee) must document the acceptance of samples from the courier and the date/time of acceptance. The following criteria must be evaluated and documented according to the SOP:

- Proper and complete COC documentation
- Presence or absence of custody seals
- Appropriate cooler temperature on temp blank
- Adherence to specified hold times
- Condition of sample containers
- Proper sample labeling
- Use of appropriate sample containers
- Appropriate sample preservation (if applicable)
- Adequate sample volume

If deviations from policy are observed, clients will be notified immediately to determine the appropriate course of action and data from the affected samples will be flagged. Samples will remain under the control of the Sample Custodian until transferred to the appropriate storage area. Following transfer to the laboratory, all samples must remain in custody.

## *8.4 Chain-of-Custody Documentation*

The chain-of-custody (COC) documents the history and trace-ability of the sampling/analytical programs. All samples received by TA-S must be accompanied by a COC and should contain the following information:

- Date/Time of Sampling
- Sample Identification
- Number of Containers
- Preservation Type
- Special Instructions
- Date of Transfer
- Collector's name
- Sample Matrix
- Location
- Type of Containers
- Requested Analysis
- Signature of Sampler
- Time of Transfer
- Project Identification

If a COC is not received with the sample delivery, the appropriate project manager must contact the client immediately and establish an adequate resolution for custodial integrity.

### *8.5 Sample Log-in*

Samples are logged in to the Laboratory Information Management (LIM) system. Each sample container is assigned a unique identification number. The following information is typically recorded in the laboratory's work order log within the LIM system.

- Client/Project Name
- Unique laboratory ID code
- Requested analyses linked to lab ID code
- Date and time of laboratory receipt
- linked field ID code
- Initials of person responsible for the entries

### *8.6 Sample Storage*

Samples, sample fractions, and/or sample extracts will be stored in a controlled environment of the type dictated by the analytical protocol. For refrigerated areas, the Sample Control Manager (or designee) will monitor and record storage temperatures as specified in the appropriate SOP. TA-S is a controlled access facility, and as such, all sample storage areas within the laboratory are deemed secure and under custodial integrity.

### *8.7 Sample Custody*

A sample is considered to be under custody if it:

- Is in the physical possession of the analyst
- Is in view of the analyst
- Is stored and secured within a controlled access area

## *9.0 ANALYTICAL QUALITY CONTROL*

### *9.1 Objectives*

Analytical Quality Control (QC) refers to the routine application of statistically based procedures to evaluate and control the reliability of results from analytical measurements.

9.1.1 The types of QC samples employed and their frequency of use is derived from the following sources:

(a) Quality control practices outlined in the reference documents associated with the analytical methods themselves. For instance, EPA SW-846 method 7000 establishes general quality control requirements for metals analyses while Method 8000 establishes the same for organic analyses.
(b) Other quality control measures set out in the laboratory evaluation guidance documents under which laboratory accreditation is maintained (i.e. ISO/IEC Guide 17025).
(c) Program specific requirements.

9.1.2 At a minimum the following essential QC parameters are monitored:

(a) Process or instrument contamination through analysis of blanks.
(b) Matrix bias through analysis of Matrix Spike samples.
(c) Precision through the analysis of Duplicate samples or duplicate spikes.
(d) Accuracy through the analysis of Surrogate spikes and Laboratory Control Samples.
(e) Method Detection Capability through performance of MDL and/or IDL studies.

(f) Comparability of data to outside sources through analysis of Blind Performance Evaluation samples and second source calibration checks.
(g) Instrument and Method performance through analysis of calibration standards.

9.1.3 Control limits and Data Quality Objectives for the essential QC parameters listed above are derived by reference to:
- Acceptance criteria published in the individual analytical methods employed.
- Acceptance criteria mandated through contractual agreement or program requirements.
- Acceptance criteria derived "in-house" through the use of a statistically valid measurement technique such as control charting.

9.1.4 Outliers are identified and appropriate corrective action is taken according to the guidelines given in the applicable SOPs for each analytical area or designated in a specific program.

## *9.2 Analytical Batch and QC Samples*

9.2.1 Analytical Batch
Samples to be analyzed are grouped together in a batch. The number and frequency of QC samples to be analyzed are assigned on a per batch basis. TA-S conforms to the definition of an analytical batch provided in Chapter 1 of SW-846:

> A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

The frequency and type of QC samples within a batch will conform to the specific requirements of a program, the mandated test method or applicable regulation as specified in the applicable SOP. All analytical batches will contain a minimum of the following QC samples:
- one method blank
- one set of duplicates (sample duplicates, spiked duplicates or Laboratory Control sample duplicates)
- some form of reference sample (blank spike, matrix spike or certified reference material)

This minimum will often be exceeded by the set of quality control samples dictated by each specific methodology or specific program requirements. Standard operating procedures must clearly document the set of quality control samples that will be incorporated into analytical methods and take precedence in establishing analytical frequency.

9.2.2 QC Samples
Quality Control samples are employed at TA-S as a means of assessing method performance on an on-going basis. The following types of QC samples are analyzed to meet the objectives outlined in Section 9.1 above.

9.2.2.1 Surrogate Spikes

In most organic analyses, surrogate compounds are spiked into all field and QC samples. Surrogates are a check on efficiency of the extraction. The percent recovery of surrogates is documented and compared to established control limits. The use of surrogates provides a technique for monitoring the degree to which the associated target analytes can be recovered from each specific sample's matrix.

9.2.2.2 Matrix Spikes, Blank Spikes and Reference Samples

Accuracy measurements are performed to verify the agreement of an analytical result with the certified value. Depending upon the specific requirements of the method, either an environmental sample of the appropriate matrix or a laboratory blank matrix may be spiked with a known quantity of the analyte(s) and analyzed in the same manner as the rest of the analytical batch. Additionally, reference samples are available from many commercial vendors. Reference samples consist of real-world samples or commercially prepared lots of spiked matrices which have been statistically characterized through inter-laboratory comparisons to obtain reference or "true" values for a selected list of target analytes in the sample. The percent recovery (%R) of an analyte in a spiked or reference sample is evaluated against the control limits set for that analyte. Percent recovery is calculated as follows:

$$\%\ Recovery = \frac{(Conc.\ of\ Spike) - (Conc.\ of\ Sample)}{Spike\ Conc.\ Added} * 100$$

9.2.2.3 Sample And Spike Duplicates

(a) Results of duplicate sample analyses, duplicate spike analyses and/or duplicate reference sample analyses can be used to determine precision within each batch. The relative percent difference (RPD) between the two duplicates is evaluated against the control limits established for the analyte. The RPD is calculated as follows:

$$Relative\ \%\ Difference = \frac{|D1 - D2|}{(D1 + D2)/2} * 100$$

$D1$ = Result of first duplicate

$D2$ = Result of second duplicate

(b) Unless otherwise specified by the analytical method, associated reference guidance or a client-specific project plan, the RPD between spiked samples will be calculated using the absolute values of their measured concentrations, and not the values of their percent recoveries.

(c) Unless otherwise specified, control limits for RPD are based upon representative mid-level responses. For most methods performed within the laboratory, RPD values will increase dramatically as the absolute values of the replicates approach the reporting limit for the analyte. Necessity for corrective action will not, therefore, be indicated when low-concentration replicates (i.e. one or both replicates less than 5 times the MRL) yield an RPD value above the control limit.

9.2.2.4 Blanks

(a) Method Blanks

The method blank is used to measure the analytical response attributable to all factors other than the analyte in the sample. Method blanks are analyzed identically to the samples; however, they are prepared from laboratory matrices that do not contain analytes. The specific frequency of use for method blanks during the analytical sequence is generally defined in the specific standard operating procedure for each analysis.

Method blank acceptance criteria shall be in accordance with that documented in the analytical SOP or as documented in project data quality objectives. Analytes detected in the method blank at levels above the MRL shall be investigated and corrective action taken. In situations where method blank contamination is reported, the samples within the batch containing similar contamination shall be flagged accordingly.

(b) Calibration Blanks

Calibration blanks are prepared and analyzed along with calibration standards. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

(c) Instrument Blanks

Blank reagents or reagent water may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

9.2.2.5 Method Detection Limit (MDL)

The Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte. For operational purposes, when it is necessary to determine the MDL in the matrix, the MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of seven analyses of a matrix spike containing the analyte of interest at a concentration three to five times the estimated MDL.

Estimate the MDL as follows:
Obtain the concentration value that corresponds to:
a) an instrument signal/noise ratio within the range of 2.5 to 5.0, or
b) the region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).

9.2.2.6 Method Reporting Limits

Method Reporting Limits (MRLs) are defined as the lowest value to which the laboratory will report an unqualified quantitative result for an analyte. In accordance with SW-846 guidance, the lowest concentration standard employed for initial calibration or analyzed in conjunction with samples defines the reporting limit for each analyte. They are generally assigned as multiples of the MDL. If required by contract or protocol, results obtained below the method reporting limit but above the corresponding MDL may be reported if flagged as estimated values.

9.2.3 Traceability of Measurements

Procedures for ensuring the traceability of measurements must be documented in appropriate SOPs. These SOPs must adequately address the procedures and guidelines for selecting, purchasing, handling, storing, monitoring, and using standards, reagents, reference materials, equipment, and services. SOPs, as appended to this document, must be available to all laboratory personnel for review and reference.

## *9.3 Instrument and Equipment Calibration*

9.3.1 Instrument Calibration

Instrument calibration procedures vary significantly between the various types of analytical methods performed. As a general policy, calibration of instrumentation is performed in accordance with the protocols and frequencies cited in the applicable guidance documents associated with the analytical methods employed by the laboratory (i.e. SW-846 method 7000 for metals, method 8000 for Organics). Actual procedures are clearly defined by the standard operating procedure (SOP) associated with each method. Acceptance criteria for establishing acceptable calibration performance are also given in the reference procedures and the analytical SOPs.

9.3.2 Standards

Standard reference materials used for instrument calibration may be obtained from a variety of sources, providing the material is certified and, whenever possible, N.I.S.T traceable. Standards are purchased from commercial suppliers, dated upon receipt, and replaced as needed according to the methodology or manufacturer recommendations. Standards are logged in to the Laboratory Information Management System (LIMS) and assigned a unique identification number. The following information is typically recorded in the laboratory's electronic standards log within the LIMS:

- Standard ID
- Description of Standard
- Department
- Solvent type/Lot #
- Final Volume
- Expiration Date
- Preparation Date
- Prepared By
- Source Type (daughter solution or primary stock)
- Solution Type (Spike, Surrogate or Other)
- Descriptive Comments (Lot #'s, prep instructions, etc.)
- Parent Standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount Used (if applicable)
- Component Analytes
- Final concentration of each analyte

Labels can be generated from the LIMS or prepared by hand. At a minimum, all standards must be labeled with the Standard ID, Description of the Standard, Date Prepared, Expiration Date, and the initials of the chemist preparing the standard. Standard ID numbers are documented on all associated analytical raw data so that the analytical procedure can be unambiguously traced to the certified reference materials used in generation of the data.

9.3.3 General Equipment

**Balances** - Calibration and service is performed at least once per year by an outside company. Balance calibration is verified by laboratory personnel using certified reference weights each day of use. The laboratory's reference weights are evaluated and re-calibrated by a certified metrology laboratory at least once a year.

**Critical thermometers** - Thermometers associated with analytical procedures, sample storage or reagent storage are checked against a N.I.S.T. traceable reference thermometer on at least an annual basis. The laboratory's NIST reference thermometers are evaluated and re-calibrated by a certified metrology laboratory at least once every three years.

**Temperature Control Logs -** Temperature control logs are used for ovens, refrigerators, incubators, and other temperature controlled equipment. Temperature logs provide a written record of operating consistency for monitored equipment and help to immediately identify or even prevent equipment malfunctions which might compromise sample integrity or data quality.

**Deionized Water Monitoring -** The conductivity of the laboratory deionized water is monitored daily by checking a conductivity gauge attached to the deionizing system. Analytical conductivity readings are also taken at points of use throughout the laboratory on a weekly basis.

**Mechanical Pipette Calibration -** Mechanical pipettes are checked to ensure that they are capable of delivering their indicated volumes within specific accuracy and precision requirements. The specific requirements and procedures for performing and documenting pipettes calibration are detailed in a SOP.

## *9.4 Control Charting and Acceptance Criteria*

9.4.1 Control Charting

Control charts are statistical mechanisms used to graphically monitor data quality objectives in the laboratory. Quality Control sample results are grouped and plotted as individual points. Warning and control limits are calculated for each data quality parameter at +/- 2 and +/- 3 times the standard deviation from the mean of the group of data points used to construct the control chart. These warning and control limits trigger levels of corrective action as defined in specific laboratory SOPs.

The database program utilized within by TA-S permits rapid evaluation of control charts for individual or grouped sets of analyses and matrices. As a general policy, control charts should be evaluated by the analysts associated with their methods as a normal part of analytical data review procedures. Control charts are evaluated to detect trends in the performance of the method with respect to the charted QC Samples and to assess the applicability of the control limits currently in place for the methodology.

9.4.2 Acceptance Criteria

Acceptance criteria (Control Limits) for QC Samples are established to evaluate laboratory precision and bias based on the analysis of control samples. Typically, control limits for bias are based on the historical mean recovery plus or minus three standard deviation units, and control limits for precision range from zero (no difference between duplicate control samples) to the historical mean relative percent difference plus three standard deviation units.

QC Sample acceptance criteria are often established according to individual method requirements. When a method does not define limits, analysts, supervisors, department managers, and other technical staff in cooperation determine limits with the QA Manager. Control limits may be based on both evaluation of historical performance and statistical data. In the absence of sufficient data to establish meaningful control limits, the QA Manager and Department Managers work together to set default limits based upon related methodology or industry standards.

Analysts and Department Managers evaluate control limits at least annually. The need for changes may be indicated by statistical evaluation of QC samples, review of control charts or by other factors associated with the procedure. Changes to the control limits assigned to an analysis must be reviewed and approved by the QA Manager.

In an effort to maintain continuity and consistency, control limits shall be consistent with those specified in the appropriate analytical protocol. Control limits based upon statistical interpretation (control charting) of historical data should fall within those specified in the appropriate analytical protocol, and any exceptions to this treatment shall be reviewed/approved by the QA Manager and/or Technical Director prior to use.

## *9.5 Methods and Method Development*

9.5.1 Selection of Methods

The analytical methods employed within the laboratory must be based upon sound laboratory practices and established scientific principles. In general, TA-S follows procedures established by EPA SW 846 Methods, EPA Series 500 and 600 Methods, ASTM Standards, Code of Federal Regulations Title 40, and Standard Methods (applicable promulgated edition). TA-S must follow specific project or regulatory program required methodologies. When specified, such requirements will be followed.

9.5.2 Method Development and Initial Demonstration of Capability

Development of a method encompasses the completion of a standard operating procedure along with any requisite initial demonstrations of capability (IDC). The standard operating procedure must clearly define how TA-S plans to implement the referenced method. Any significant deviations from the referenced method must be clearly described. In almost all cases, an IDC will include a method detection limit (MDL) study, but may also include one or more of the following items:

- Instrument Detection Limit (IDL) study
- Linear Range (LR) study
- Precision and Accuracy (P&A) study
- Desorption Efficiency (DE) study
- Retention Time Window (RTW) determination
- Standard Reference Material (SRM) analysis (if available)
- Single-blind Performance Evaluation (PE) sample analysis (if available)

When not otherwise specified in the analytical method reference or associated guidance documents, the QA Manager and Department Managers work together to determine which of these items will be required as part of the IDC.

The various studies comprising the Initial Demonstration of Capability are performed in accordance with the applicable reference documents associated with the analytical methods. Unless otherwise specified, MDLs are determined in accordance with the procedure outlined in 40 CFR part 136 Appendix B (rev 1.01). Where methods provide specific performance criteria, acceptable performance on IDC studies must be documented for all analytes reported for the analytical technique.

9.5.3 On-Going Demonstration of Capability

Due to incremental changes in analytical equipment, personnel practices and related analytical variables, demonstrations of capability must be performed on routine analytical procedures at least once annually. A new demonstration of capability must also be performed when the analytical process undergoes a major change. Unless otherwise specified in the analytical method reference or associated guidance documents, the QA Manager and Department Managers work together to determine whether or not a revision to an on-going analytical process constitutes a major change.

## *10.0 DATA GENERATION, VALIDATION AND REPORTING*

Specific procedures for reducing, verifying and reporting data are outlined within the corresponding SOPs maintained by the QA Manager. General policies are outlined below:

### *10.1 Data Generation*

All observations, measurements and calculations for standards, calibrations, preparations, digestions, cleanup procedures, sample measurement, quality control sample measurement and general analytical conditions are documented via hand-written notations in hard-bound logbooks, designated record-keeping forms, or are printed from electronic data systems and compiled in a comprehensive manner to provide quick reference to reviewers.

All hand-written notations in logbooks, record forms or hard-copy printouts of analytical records must be marked with the initials of the person responsible for the notation along with the date the notation was performed. Any corrections to the analytical data must be performed by marking through the errant information with a single line followed by the initial of the person performing the correction and the date when the correction was performed. In some cases, it may be necessary to provide further explanation on the analytical records regarding the reasons for a correction.

Once the analyst is satisfied that the analytical data have been generated using sound laboratory practices and meets all applicable quality control requirements, the data are transferred to an electronic data base via hand-entry into the database's programmed user interface or through DataTool, Element's automatic upload for electronic data files.

### *10.2 Validation and Review*

TA-S's general policy for data validation requires that all data generated by the laboratory be subjected to at least three levels of review before being released to the client. The levels of review are outlined as follows:

First level: Bench-level review of analytical data against QA/QC policies, SOPs and pre-determined performance criteria by the analyst responsible for conducting the analysis. This level of review is typically performed using a data review checklist and within the laboratory's database program which provides the reviewer with preparation information, standards concentrations, detection/reporting limits, QC acceptance limits, initial results, percent solids and final calculated results. Acknowledgment of first level review is indicated when the analyst signs and dates the checklist and within the database program when the analyst updates the status of the analytical results to a Needs Review status.

Second level: Peer and/or supervisory review of the documentation from the analysis to confirm the observations and calculations of the original analyst, compliance with applicable policies and procedures and to confirm the absence of transcription errors. This level of review is typically conducted using a data review checklist and hard-copy records from the analysis along with the laboratory database review screen. Acknowledgment of second level review is indicated by signing and dating the checklist and within the database program when the reviewer updates the status of the analytical results so that the project management group may proceed with analytical reporting.

Second level reviewers may be peer analysts who have completed the necessary training to review the specific type of analytical data or they may be supervisors, department managers or other management team staff with the appropriate experience and method knowledge to conduct the review. The second level review may not be performed by the original analyst.

Third level: Project level review of the results focuses on the completeness of the analytical data, comparability between associated tests, and confirmation of compliance with project specifications or other client expectations, consistency with historical data, and appropriateness. This type of review is typically conducted by producing an electronic draft of the analytical report from the laboratory database program. During preparation of the draft, the Laboratory Information Management System (LIMS) program automatically checks for and lists any sample results involving out-of-control QC samples, modified analyte lists, or any special data flags which may have been assigned by the primary or secondary reviewers. The Project Manager is responsible for conducting third-level review. When a Case Narrative is required, the Project Manager is also responsible for compiling any comments from Non-Conformance reports or analyst notations in the LIMS to explain exceptional incidents associated with the analytical process.

The third level review may not be performed by the original analyst but it may be performed by the second level reviewer when this person is also a Project Manager or otherwise responsible for generation of the analytical report to the client.

### *10.3 Reporting*

Final reports are generated by Project Managers after all three levels of review have been successfully completed. Generation of the final report is accomplished when the Project Manager generates and saves the electronic version of the draft report to a centralized electronic archive and then prints the file on laboratory letterhead. In order to ensure consistency between the different formats of analytical data, electronic data files (Electronic Data Deliverables or "EDDs") may be produced directly from the Laboratory Information Management System (LIMS) at the same time the hard-copy final report is generated.

Copies of the signed final report are maintained along with the project folder for each work order. Project folders and supporting analytical raw data are archived for a minimum of seven years unless otherwise specified by client contract or other expressed agreements.

TA-S offers four levels of report formats to meet the needs the client. Level I, III, IV and electronic deliverables are provided upon request. The default format for analytical results is Level II.

Level I: Standard Analytical Summary Report – analytical results summary.

Level II: Standard Analytical Report – analytical results summary and batch QC summary.

Level III: Standard Analytical Report – analytical results summary, batch QC summary, continuing calibration summary, and sample raw data.

Level IV: Standard Analytical Report – analytical results summary, QC summary with site-specific QC, QC raw data, continuing calibration summaries, continuing calibration raw data, initial calibration summaries, initial calibration raw data, sample raw data, case narrative, chain of custody and any other pertinent data requested by the client or their authorized representative.

TA-S provides a variety of reporting formats, from electronic deliverables to our standard paper report. In general, TA-S reports include:

Summary Page: Client Sample ID, Laboratory Sample ID, Sample Matrix, Date/Time Sampled, *Date/Time Received* and Header with Client and Project information.

Sample Page: Client Sample ID, Laboratory Sample ID, Analytical Results, *Dilution Factor*, Method Reporting Limit, Data Qualification Codes, Batch Identification, Preparation Date, Analysis Date, Specific Method, Units, Matrix, Analyte Identification and Header with Client and Project information.

QC Page: Laboratory Sample ID, QC Results, *Spike Level*, QC Acceptance Limits, Method Reporting Limit, Data Qualification Codes, Batch Identification, Preparation Date, *Preparation* Method, Units, Analyte Identification and Header with Client and Project information.

Notes and Definitions Page: Data Qualifiers, Abbreviations, and Header with Client and Project information.

# *11.0 CORRECTIVE ACTION*

## *11.1 Policy*

It is TA-S's policy to ensure continuous acceptable quality levels for all lab services provided. In order to meet this goal, a system has been established to assure that conditions adverse to quality are promptly identified and corrected. Acceptance criteria pertinent to measurements and/or traceability of measurements are documented in the applicable SOPs. Required corrective actions for situations outside of these acceptance criteria are also detailed in the SOP. Monitoring and adherence to these acceptance criteria and/or corrective actions is completed by both bench and management level personnel.

## *11.2 Bench Level Corrective Action*

Isolated events which may have a negative impact on quality are documented at the bench level through use of a Non-Conformance Report. At a minimum, the form used must serve to document the date/time, personnel involved and conditions of the problem, along with the date/time, explanation of resolution and supervisory or QA approval.

Unless otherwise addressed in the SOPs associated with an analytical procedure, individual events that may affect quality are documented on a non-conformance report and brought to the immediate attention of the Department Manager and Project Manager. The Department Manager is responsible for notifying and consulting with Project Managers, the QA Manager or senior operational managers as necessary to resolve the issues associated with the non-conformance. Project Managers are responsible for notifying and consulting with the client regarding non-conformances.

Examples of non-conformance events which may not otherwise be addressed in analytical SOPs might include one time variations in method parameters due to an unusual matrix, evidence of unusual laboratory contamination, loss or damage to the sample or its extract, or unusually high concentrations of interferences which render the intended method inappropriate for the sample. When such an event is recognized, its impact upon quality is assessed and corrective action is decided upon. The Department Manager, Supervisor and/or QA Manager approve the corrective action. The Project Manager files a copy of the non-conformance report with the project folder to permit the reconstruction of the data set at a later date, if necessary. A second copy of the non-conformance report is maintained by the QA Manager to monitor trends in the laboratory.

## *11.3 Management Level Corrective Action*

The Quality Assurance Manager may initiate investigation and corrective action by issuing a formal Corrective Action Report (CAR) or similar suitable report in any of the following situations:

- When an audit (see Section 12, *Laboratory Evaluation and Audits*) reveals circumstances that may adversely affect quality as determined by the QA Manager.
- When review of non-conformance reports reveals a significant trend which may adversely affect quality.
- When a technical complaint is received from clients, auditors, regulatory representatives or TA-S staff indicating problems associated with quality.

The progress of corrective actions is documented through the CAR form. At a minimum, the CAR form must serve to document the following corrective action sequence:

(a) Identify the problem and define its impact on data quality.
(b) Assign responsibility for investigation and proposed completion date.
(c) Investigate and determine the cause of the problem by promptly auditing those areas of activity and responsibility.
(d) Determine a course of corrective action.
(e) Assign responsibility for implementing the corrective action and proposed completion date.
(f) Verify that the corrective action was successful.
(g) Evaluate the effectiveness of the corrective action in preventing further events that may impact adversely on data quality.
(h) The QA Manager will maintain records of the complaint and subsequent actions.

## *12.0 LABORATORY EVALUATION AND AUDITS*

Laboratory audit procedures provide assurance that the quality control process is being performed effectively. Audits specifically provide management with an on-going assessment of the quality of results produced by the laboratory, including how well the policies and procedures of the Quality Assurance System are being executed. They are also instrumental in identifying areas where improvement in the QA System will increase the reliability of data. There are three types of audits: System Audits, Technical Audits and Performance Audits.

### *12.1 Quality System Reviews - System and Technical Audits*

TA-S system audits consist of evaluations of the measurement system to ensure proper care and use, while technical audits assure that the laboratory is adhering to policies and procedures set forth in this QAM, the SOPs and the published methods. A component of TA-S's technical audit is the Data Quality Audit. In a data quality audit, the technical completeness and accuracy of a data set are evaluated. These evaluations are completed on 10% of the analytical reports generated by a laboratory. Data quality audits are also conducted at the request of a client or a TA-S project manager.

System and technical audits are planned, organized and performed by the QA Manager or other qualified personnel, according to a predetermined schedule and when requested by management. System and technical audits may be combined, as long as all elements/areas of the laboratory are reviewed over the course of one year. The results of all QA inspections and resulting corrective actions are filed together and are under the control of the QA Manager. A report is prepared based on the audit and is distributed to management in a timely manner. The report is also discussed with laboratory personnel so that a concerted effort can be made to correct all deficiencies and to provide positive feedback. Where audits findings cast doubt on the correctness or validity of reported test results, the laboratory shall take timely corrective action and shall notify, in writing and within three business days, any client whose results were affected.

### *12.2 Performance Audits*

Performance Testing (PT) is a quantitative assessment of the accuracy of an analysis. Hence, it is a means to evaluate the performance of laboratory technicians and the instrumentation or analytical systems on which they work. TA-S participates in both internal and external laboratory check sample programs as a means for examining overall laboratory performance, as well as, to qualify for various federal, state and independent certification programs. The laboratory is required to perform at least two proficiency testing studies per year per program (e.g., drinking water), utilizing NIST approved PT samples, to comply with NELAC requirements.

## *13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT*

It is the responsibility of the Quality Assurance Manager to maintain consistent and effective lines of communication with laboratory and corporate management. To facilitate this communication, the following system of reporting has been established:

(a) The QA Manager will prepare a Quality Assurance Summary report covering the activities at TA-S on *a monthly basis*. The reports will summarize QA activities on such topics as NCR events, data investigations/recalls, accreditation proceedings, staff training, internal audits, external audits, performance evaluation results, trend analysis, client feedback, and reviews and updates to SOPs, MDLs and control limits that occurred (or were received) during the previous month. These reports are submitted to the Laboratory or Technical Director for comments and approval. The QA Manager will follow-up on any action items resulting from the Director's review. The approved report is forwarded to TA Corporate QA and is intended for use in the Director's annual assessment and report (1.3.2).

(b) The QA Manager will provide formal notification to the Laboratory Director, Department Managers and Project Managers whenever an accreditation status changes.

## *14.0 DOCUMENTS AND DOCUMENT CONTROL*

This section outlines the key types of documents, their preparation, control and storage.

### *14.1 Analytical Reports, Data and Associated Documents*

Records generated as the result of analytical procedures may include the following: Analytical Reports, Chains of Custody, Logbooks, Lab Notebooks, Bench Sheets, Nonconformance Reports, Chromatograms and Spectra. All such records whether in electronic or hard-copy format are stored chronologically by batch or project and kept for a minimal period of seven years.

### *14.2 Document Control*

TA-S requires that document control procedures ensure:

(a) Pertinent issues of appropriate documents are available in all locations.
(b) Invalid or obsolete documents are promptly replaced with updated versions and reasonable notification is provided as to the newly available updates.
(c) All reasonable precautions will be exercised to protect records from damage or tampering.
(d) Data is archived in compliance with laboratory SOPs and applicable corporate policies.

### *14.3 Controlled Documents*

The following documents are subject to document control procedures within the laboratory:

- Quality Assurance Manual
- Standard Operating Procedures
- Employee Policy Manual

While these documents are controlled internally, copies of these documents may be circulated for review outside of the laboratory. These external copies will not be subject to document control procedures.

(a) Quality Assurance Manual (QAM)
For tracking purposes, all editions of the QAM will be issued with revision numbers and effective dates on each page of the document. The signed original copy will be kept in the QA Department. The QA Department will be responsible for distribution and tracking of all copies of the document to ensure that all staff members have access to the most recent revision and that all obsolete revisions are properly retired from use. TA-S employees also have access to a secured, electronic version of this document on the intranet.

(b) Standard Operating Procedures
For tracking purposes, all SOPs are issued with unique document numbers, revision numbers and revision/effective dates. The QA Department will maintain a file of original documents, produce sufficient copies to ensure that all staff members have access to the most recent revisions and retire all obsolete revisions. Obsolete revisions of all SOPs will be archived by the QA Department. TA-S employees also have access to secured, electronic versions of the SOPs.

(c) Employee Policy Manual
For tracking purposes, the Employee Policy Manual is issued with a unique document number and effective date. The HR Department will be responsible for distribution and tracking of all copies of the document to ensure that all staff members have access to the most recent revision and that all obsolete revisions are properly retired from use. TA-S employees also have access to a secured, electronic version of this document on the intranet.

## *15.0 CONTROL OF COMPUTER DATA AND SOFTWARE*

TA-B uses computers and software programs for:

- Control and data acquisition for laboratory instrumentation
- Automation and presentation of routine calculations
- Storage and retrieval of analytical data
- Compilation of analytical and business reports

Computer systems are located throughout the laboratory with information gathering, review, security, and backup activities coordinated primarily through a local area network (LAN). An Information Systems (IS) Manager and/or a designated Systems Administrator (SA) shall bear responsibility for management of all computer systems within the laboratory.

### *15.1 Personnel and Responsibilities*

The Information Systems Manager and/or System Administrator is responsible for managing the security of all computer systems used within the laboratory. This includes:

- Controlling access to computer systems and software
- Maintaining software documentation and licensing
- Coordinating routine backup procedures

### *15.2 Access Control*

All computers and software are maintained in the laboratory building. Portable or laptop computing devices are assigned only to employees who have been cleared for unrestricted access to the facility (possess key and alarm code). The laboratory building is a secured facility. Access to the facility is denied unless escorted by TA-S personnel.

Access to computers and software is restricted to authorized personnel. Password protection is employed for initialization of the Laboratory Information Management System (LIMS) and for access to various shared resources on the LAN. Within the LIMS database program, access to view and edit data is limited through control of individual user permissions.

Remote access to the LAN (i.e. dial-up network connection, Internet, remote-administration) is controlled through use of individual dial-up accounts with specific passwords and permissions. Commercially available virus scanning and protection software is to be maintained resident on the laboratory network server and/or individual computers for automated detection and elimination of any potentially damaging files.

Original versions of computer software, documentation, license agreements, and backup copies are maintained in the office of the Information Systems Manager and/or System Administrator or some other limited access location (i.e. Lab Manager's office or QA Manager's office). All installation and/or reinstallation of computer software will be carried out under the supervision of the Information Systems Manager and/or System Administrator.

The Information Systems Manager and/or System Administrator are responsible for maintaining records indicating the locations of all hardware and licensed software. Records will include documentation of maintenance, repair and any software or hardware problems encountered.

### *15.3 Data Backup*

Procedures for backing up computer data are coordinated by the Information Systems Manager and/or System Administrator, the QA Managers and the Department Managers, but are routinely performed by the operators or users within the specific analytical departments where a data system is used. Standard Operating Procedures are maintained by TA-S to describe the equipment, processes, personnel, frequency and recovery tactics associated with computerized analytical data.

## *16.0 GLOSSARY OF TERMS*

The following terms are excerpted from EPA document SW-846, 3rd Ed. with Updates I and II:

ACCURACY: The closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will be a combination of a random component and of a common systematic error (or bias) component.

BATCH: A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

BIAS: The deviation due to matrix effects of the measured value ($X_s - X_u$ ) from a known spiked amount. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).

BLANK: see Equipment Rinsate, Method Blank, Trip Blank.

CONTROL SAMPLE: A QC sample introduced into a process to monitor the performance of the system.

DATA QUALITY OBJECTIVES (DQOs): A statement of the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data. This is qualitatively distinct from quality measurements such as precision, bias, and detection limit.

DATA VALIDATION: The process of evaluating the available data against the project DQOs to make sure that the objectives are met. Data validation may be very rigorous, or cursory, depending on project DQOs. The available data reviewed will include analytical results, field QC data and lab QC data, and may also include field records.

DUPLICATE: see Matrix Duplicate, Field Duplicate, Matrix Spike Duplicate.

EQUIPMENT BLANK: see Equipment Rinsate.

EQUIPMENT RINSATE: A sample of analyte-free media that has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is useful in documenting adequate decontamination of sampling equipment.

ESTIMATED QUANTITATION LIMIT (EQL): The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. However, it may be nominally chosen within these guidelines to simplify data reporting. For many analytes the EQL analyte concentration is selected as the lowest non-zero standard in the calibration curve. Sample EQLs are highly matrix-dependent. The EQLs in SW-846 are provided for guidance and may not always be achievable.

FIELD DUPLICATES: Independent samples that are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision of the sampling process.

LABORATORY CONTROL SAMPLE: A known matrix spiked with compound(s) representative of the target analytes. This is used to document laboratory performance.

MATRIX: The component or substrate (e.g., surface water, drinking water) which contains the analyte of interest.

MATRIX DUPLICATE: An intra-laboratory split sample which is used to document the precision of a method in a given sample matrix.

MATRIX SPIKE: An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

MATRIX SPIKE DUPLICATES: Intra-laboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

METHOD BLANK: An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process. For a method blank to be acceptable for use with the accompanying samples, the concentration in the blank of any analyte of concern should not be higher than the highest of either:

(1) The method detection limit, or
(2) Five percent of the regulatory limit for that analyte, or
(3) Five percent of the measured concentration in the sample.

METHOD DETECTION LIMIT (MDL):The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte. For operational purposes, when it is necessary to determine the MDL in the matrix, the MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of three analyses of a matrix spike containing the analyte of interest at a concentration three to five times the estimated MDL, where the t-statistic is obtained from standard references.

ORGANIC-FREE REAGENT WATER: For volatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water. Organic-free reagent water may also be prepared by boiling water for 15 minutes and, subsequently, while maintaining the temperature at 90°C, bubbling a contaminant-free inert gas through the water for 1 hour.

For semivolatiles and non-volatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water.

PRECISION: The agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses. These samples should contain concentrations of analyte above the MDL, and may involve the use of matrix spikes. The most commonly used estimates of precision are the relative standard deviation (RSD) or the coefficient of variation (CV) and the relative percent difference (RPD).

PROJECT: Single or multiple data collection activities that are related through the same planning sequence.

QUALITY ASSURANCE PROJECT PLAN (QAPP): An orderly assemblage of detailed procedures designed to produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.

RCRA: The Resource Conservation and Recovery Act.

REAGENT BLANK: See Method Blank.

REAGENT GRADE: Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

REAGENT WATER: Water that has been generated by any method that would achieve the performance specifications for ASTM Type II water. For organic analyses, see the definition of organic-free reagent water.

REFERENCE MATERIAL: A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.

SPLIT SAMPLES: Aliquots of sample taken from the same container and analyzed independently. In cases where aliquots of samples are impossible to obtain, field duplicate samples should be taken for the matrix duplicate analysis. These are usually taken after mixing or compositing and are used to document intra- or interlaboratory precision.

STANDARD ADDITION: The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.

STANDARD CURVE: A plot of concentrations of known analyte standards versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument. Standards should be prepared at the frequency specified in the appropriate section. The calibration standards should be prepared using the same type of acid or solvent and at the same concentration as will result in the samples following sample preparation. This is applicable to organic and inorganic chemical analyses.

SURROGATE: An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.

TRIP BLANK: A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples.

**Figure 1**

# TESTAMERICA ETHICS POLICY AND CODE OF ETHICAL CONDUCT

It is the policy of TestAmerica that every employee shall at all times and in all ways comply with federal, state and local laws, and that every employee shall adhere to the highest standards of ethics, morality, honesty and decency in the performance of the duties of his or her job. TestAmerica strives to create an ethical "culture" through top-down example with an emphasis on doing things the "right way" for the "right reasons". The consequences of non-compliance can be severe to both the environment and the company. The actions of one employee can jeopardize the entire company. The company has a zero tolerance policy for illegal, unethical and improper practices that affect the integrity of all data the company produces.

## 1.1 TestAmerica Code of Ethical Conduct

TestAmerica has adopted a Code of Ethical Conduct, to which each employee must adhere, as follows:

a) To serve human health and environmental interests by performing analytical and testing responsibilities in a manner that justifies the public trust.

b) To present services in a confidential, honest, and candid manner. Facility/location procedures, client names and their results are not discussed outside of the company except with an approved client agent.

c) To produce results that are both accurate and defensible.

d) To comply with all written procedures (i.e., Quality Assurance (QA) Manual, Standard Operating Procedures (SOPs), Safety Manual, Human Resources Manual, etc.). Members of management must comply with all applicable federal, state, and local laws and regulations consistent with accepted professional and analytical practices.

e) To understand and adhere to the guidelines of ethical and quality work that meet the standards required by the environmental testing industry.

## 1.2 Data Quality Assurance Program

TestAmerica wants to ensure a national standard of quality at all TestAmerica locations.

Each TestAmerica laboratory has a Quality Assurance Manual that focuses on quality related test specifications performed by that laboratory. Documented quality systems are designed to insure that work performed in the laboratory is accurate, precise, complete, comprehensive, and reflects the needs of the customer/client.

## Figure 1 (continued)

### 1.3 Ethics Quality Commitment, Objective, and Policy

TestAmerica wants to ensure quality analytical and data management services to meet the needs of customers/clients while satisfying the requirements of appropriate state and federal regulations. This enables the customer/client to make rational, confident, cost-effective decisions on the assessment and resolution of environmental problems. Protocols and procedures utilized by laboratories, with emphasis on the Quality Assurance/Quality Control (QA/QC) requirements, are based on EPA guidelines.

It is the policy of TestAmerica to incorporate quality into all analytical programs by adhering to the following practices:

a) TestAmerica will not offer any analysis for which we cannot demonstrate consistent quality and defensible analyses;

b) Employees who are aware of falsification or misrepresentation of facts regarding analytical results or the manipulation of data are required to immediately inform the appropriate member of Management;

c) TestAmerica has “Open Door” and “Open Line” Policies which enable every TestAmerica employee to have free access to the respective Manager and Corporate Officers. Such Open Door Policies are intended to foster two-way communications and provide each employee with access to Laboratory and Corporate Management. Such Policies are also intended to encourage each employee to consider it his or her duty and responsibility to “come forward”. Any employee who disagrees with or has a concern or question about any Company practice, process, procedure, or policy, or about any Supervisory/Managerial request, instruction, or directive should come forward. This includes concerns about any undue pressures placed upon an employee which adversely affects the quality of work produced. Such contact should be made to members of Laboratory or Corporate Management. Any contacts with a Manager or representative of Corporate shall be treated as “confidential”, within the confines of any legal requirements placed upon the Company, if the employee so requests. The employee may also contact their Human Resources representative.

d) No employee of TestAmerica will compare or disclose results for any Performance Testing (PT) sample, or other similar QA or QC requirements, with any employee of any other laboratory, including any other TestAmerica laboratory, prior to the required submission date of the results to the person, organization, or entity supplying the PT sample.

## Figure 2

## TestAmerica Code of Ethical Conduct Agreement

I. I understand that I am charged with meeting ethical standards in performing all of my duties and responsibilities;

II. I have been formally instructed to consider quality as an important aspect of my job responsibilities. The provisions of the "Ethics Policy and Code of Ethical Conduct" have also been reviewed with me. In as much, it is understood that ethical performance and data integrity must supersede any other operational objective.

III. I also agree to the following:

a) I shall not report data inconsistent with actual values observed or measured.

b) I shall not modify data (either sample or QC data) unless the modification can be technically justified through a measurable analytical process, such as one deemed acceptable to the laboratory's Standard Operating Procedures, Quality Assurance Manual or Technical Director. All such modifications must be clearly and thoroughly documented in the appropriate laboratory notebooks/worksheets and/or raw data and include my initials or signature and date.

c) I shall not intentionally report dates and times of analyses that do not represent the true and actual dates and times the analyses were conducted.

d) I shall not intentionally represent another individual's work as my own or represent my work as someone else's.

e) I shall not make false statements to, or seek to otherwise deceive, members of Management or their representatives, agents, or clients/customers. I will not, through acts of commission, omission, erasure, or destruction, improperly report measurement standards, quality control data, test results or conclusions.

f) I shall not condone any accidental or intentional reporting of inauthentic data by other employees and will immediately report its occurrence. If I have actual knowledge of such acts committed by any other employees, and I do not report such information to designated members of Management, it shall be considered as serious as if I personally committed the offense. Accordingly, in that event, I understand that I may be subject to immediate termination of employment.

g) I shall immediately inform my supervisor or other member of management regarding any intentional or unintentional reporting of my own inauthentic data. Such report shall be given both orally and in writing to the supervisor or other member of management contacted and to the local Quality Assurance Officer/Manager. The Quality Assurance Officer/Manager will initial and date the information and return a copy to me.

h) I shall not accept gifts of a value that would adversely influence judgment.

i) I shall avoid conflicts of interest and report any potential conflicts to the management (e.g. employment or consulting with competitors, clients, or vendors)

j) I shall not participate in unfair competition practices (e.g. slandering competitors, collusion with other labs to restrict others from bidding on projects)

## Figure 2 (continued)

## TestAmerica Code of Ethical Conduct Agreement

k) I shall not misrepresent certifications and status of certifications to clients or regulators

l) I shall not intentionally discharge wastes illegally down the drain or onto the ground.

m) I shall protect confidential client information, business information and trade secrets that are vital to the interests and the success of TestAmerica. Such confidential information includes, but is not limited to the following: Client lists, client contact representatives, specific client/project information, pending projects and proposals, scientific data, SOPs, financial information and marketing strategies.

n) I understand that any attempt by management or an employee to circumvent these policies will be subject to disciplinary action.

I understand the critical importance of accurately reporting data, measurements, and results, whether initially requested by a client, or retained by TestAmerica and submitted to a client at a later date, or retained by TestAmerica for subsequent internal use.

I understand that if any supervisor, manager, or representative of management instructs, requests, or directs me to perform any of the aforementioned improper laboratory practices, or if I am in doubt or uncertain as to whether or not such laboratory practices are proper, I will not comply. In fact, I must report such event to all appropriate members of Management including, but not limited to, the Manager, all supervisors and managers with direct line reporting relationship between me and the Manager, and the local Quality Assurance representative, excluding such individuals who participated in such perceived improper instruction, request, or directive. In addition, I may contact Corporate Quality Assurance / Ethics Compliance Officer(s) for assistance.

The Ethics and Compliance Officers are:

- Ilona Taunton: ITaunton@TestAmericaInc.com (Located in Asheville, NC)

  Office: (828) 258-3746

  Cell: (828) 712-9242

- Scott Hoatson: SHoatson@TestAmericaInc.com (Located in Portland, OR)

  Office: (503) 906-9200

  Cell: (206) 714-2171

I should obtain a ruling, in writing, as to whether such practice is or is not improper and will abide by such ruling. However, if I have not received a timely ruling, or if I believe such ruling is incorrect, I may appeal to the Division Exec VP/COO or President/CEO and will abide by such written ruling.

I understand that if my job includes supervisory responsibilities, I shall not instruct, request, or direct any subordinate to perform any laboratory practice which is unethical or improper. Also, I shall not discourage, intimidate, or inhibit an employee who may choose to appropriately appeal my supervisory instruction, request, or directive which the employee perceives to be improper, nor retaliate against those who do.

## TestAmerica Code of Ethical Conduct Agreement

I have read and fully understand all provisions of the "Ethics Policy and Code of Ethical Conduct" and realize that even one instance of variance from the above Code of Ethical Conduct will result in discipline, up to and including termination of employment. I have also viewed the 2005/2006 Ethics Presentation.

_____ _____
(Dated) (Employee's Signature)

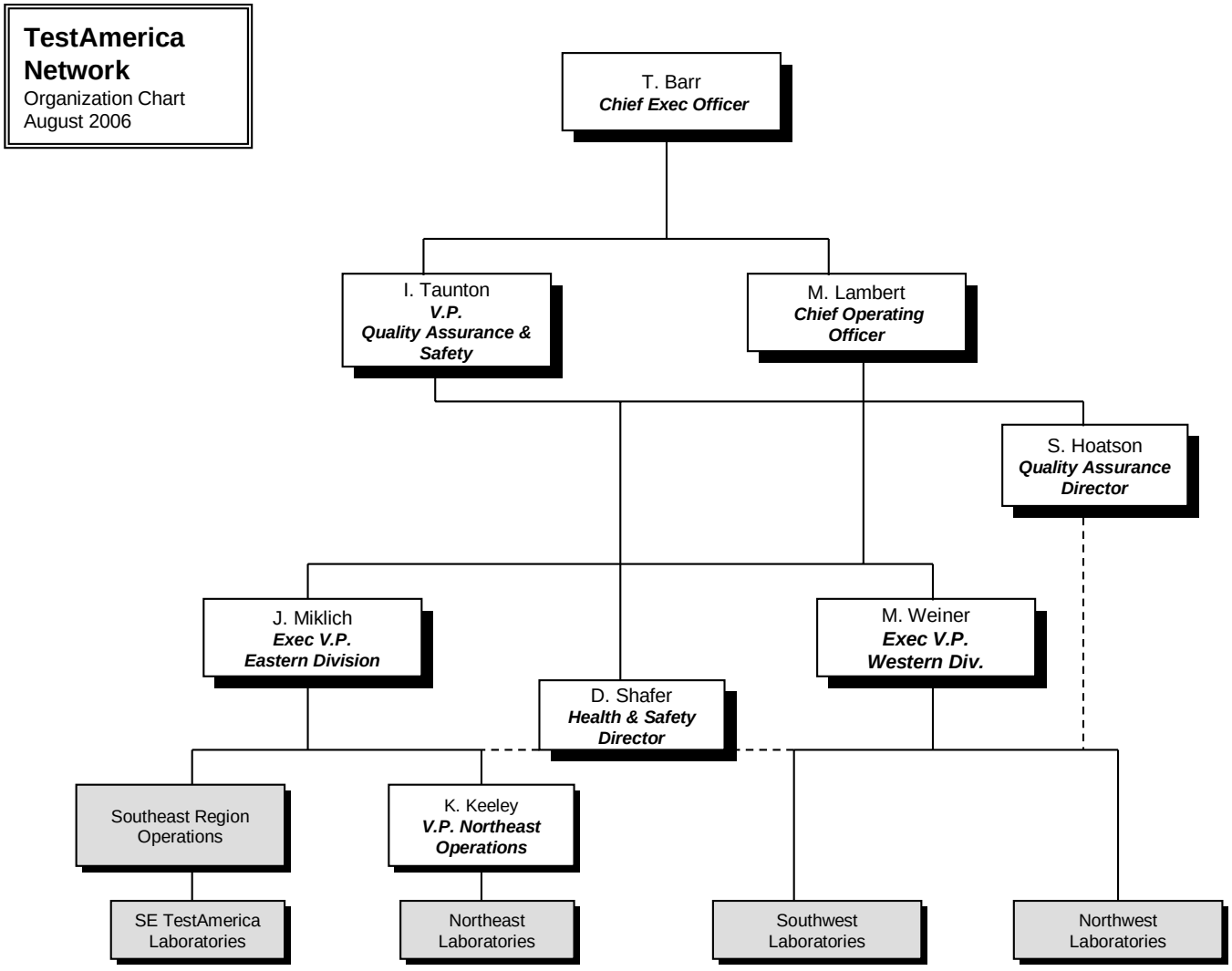
_____
(Print Name)

_____
(If applicable, Employee ID Number)

NOTE: This Ethics Policy and Code of Ethical Conduct must be signed at the time of hire (or within 2 weeks of an employee's initial receipt of this Policy, if later) and re-signed annually. Such signature is a condition of continued employment. Failure to sign will result in immediate termination of employment.

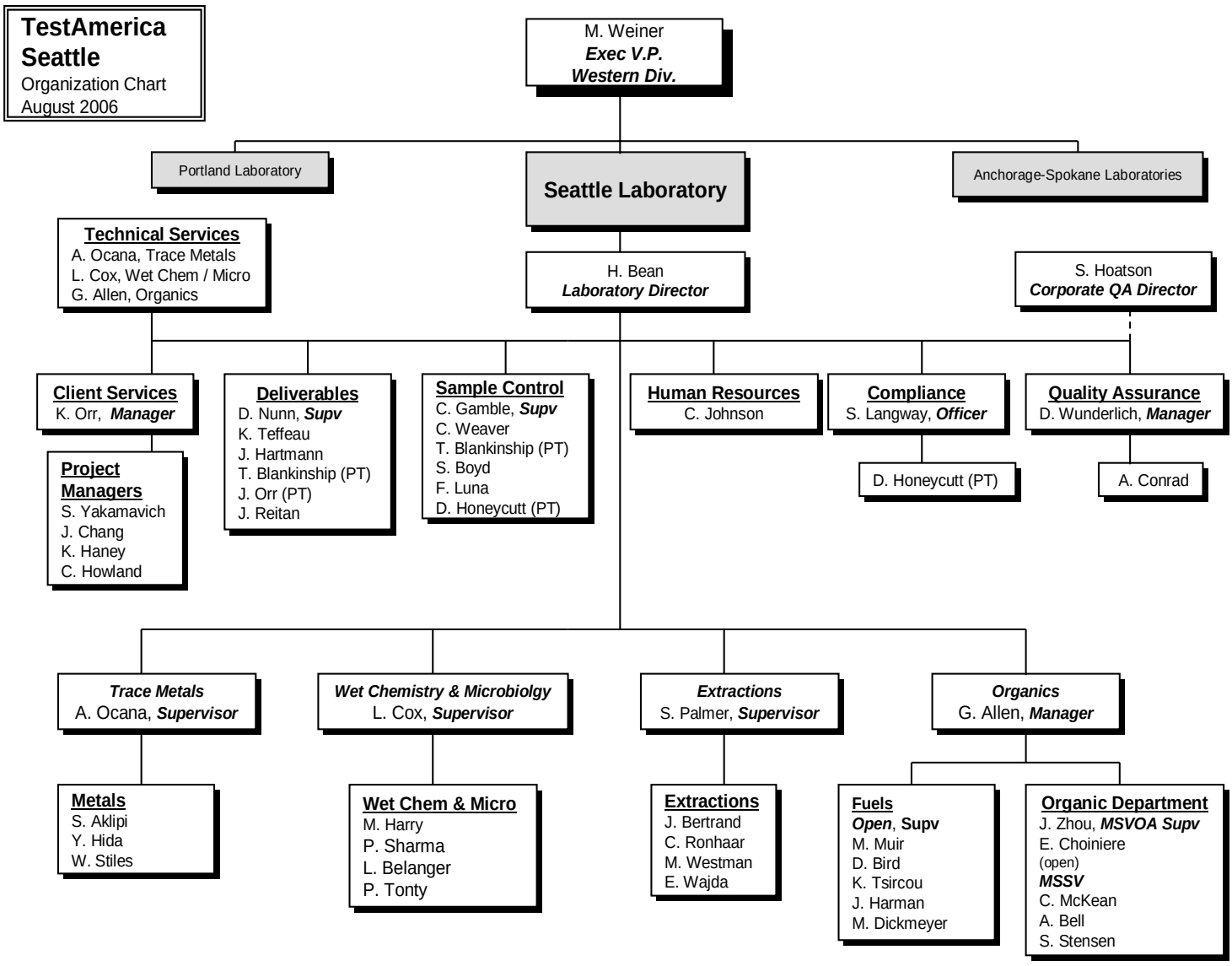
2/06

## Figure 3.0 - TestAmerica Network Organizational Chart



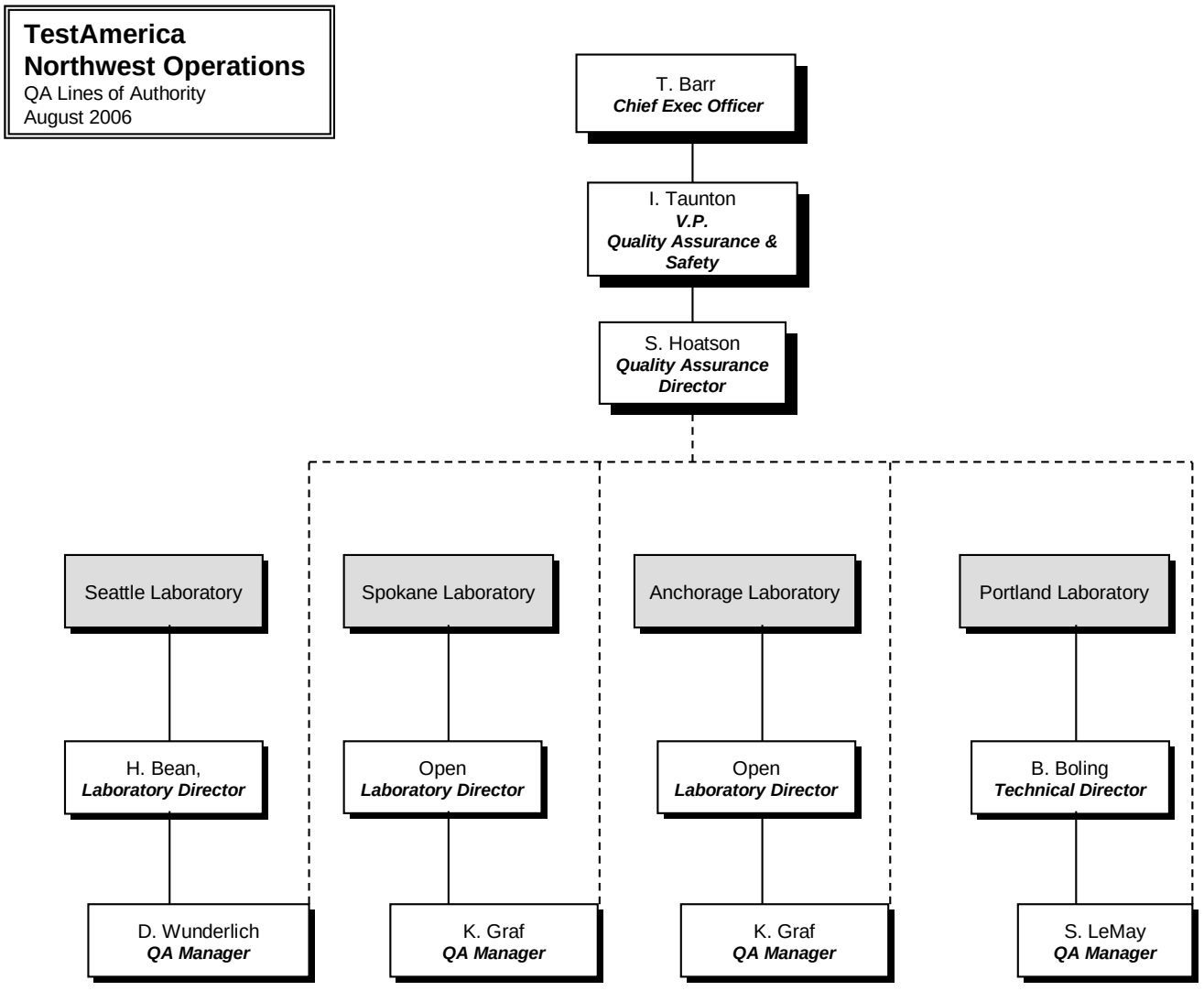

9 August 2006

## Figure 3.1 - Organizational Chart




17 August 2006

## Figure 4 - QA Lines of Authority




9 August 2006

## Figure 5 - Facility Floor Plan

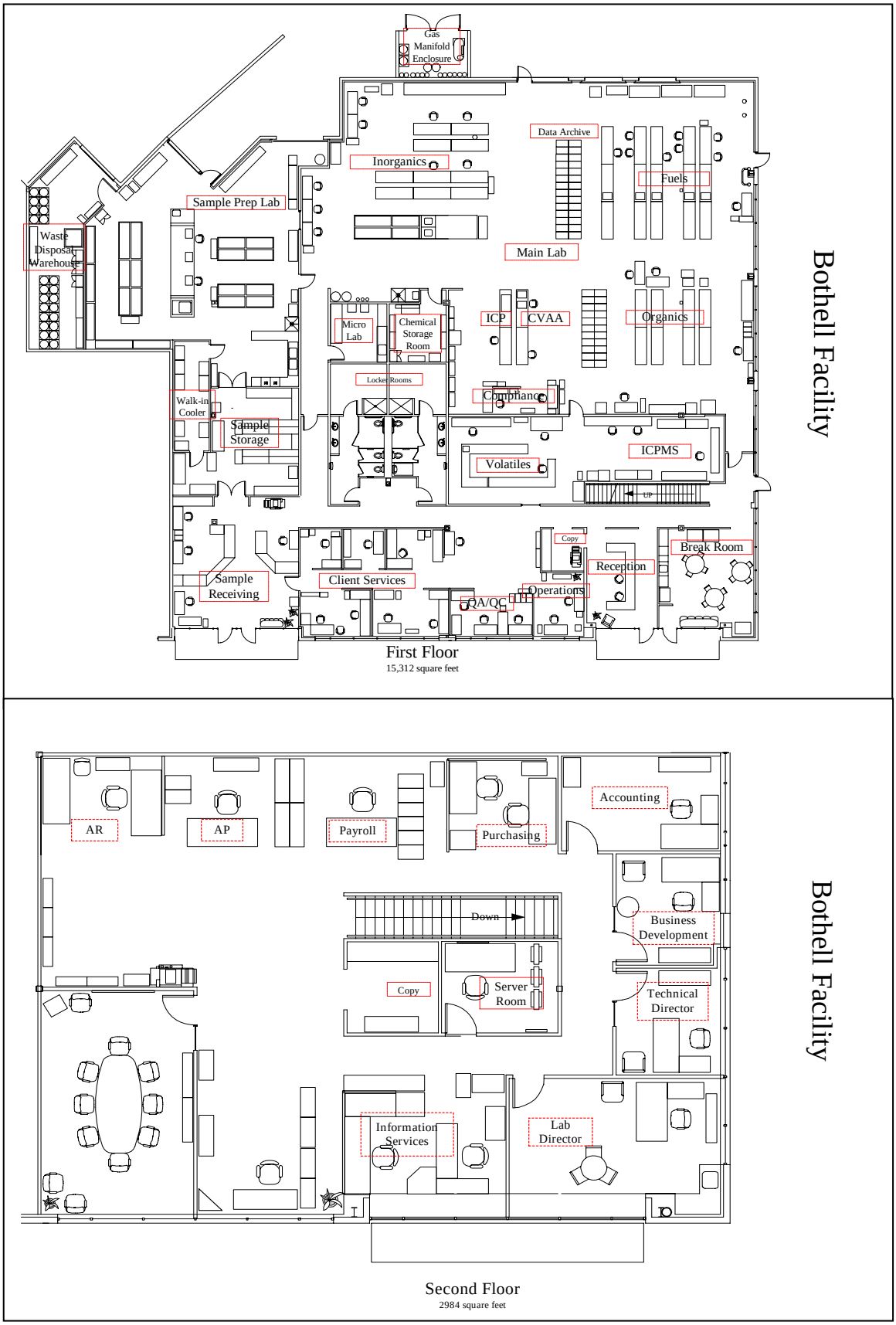
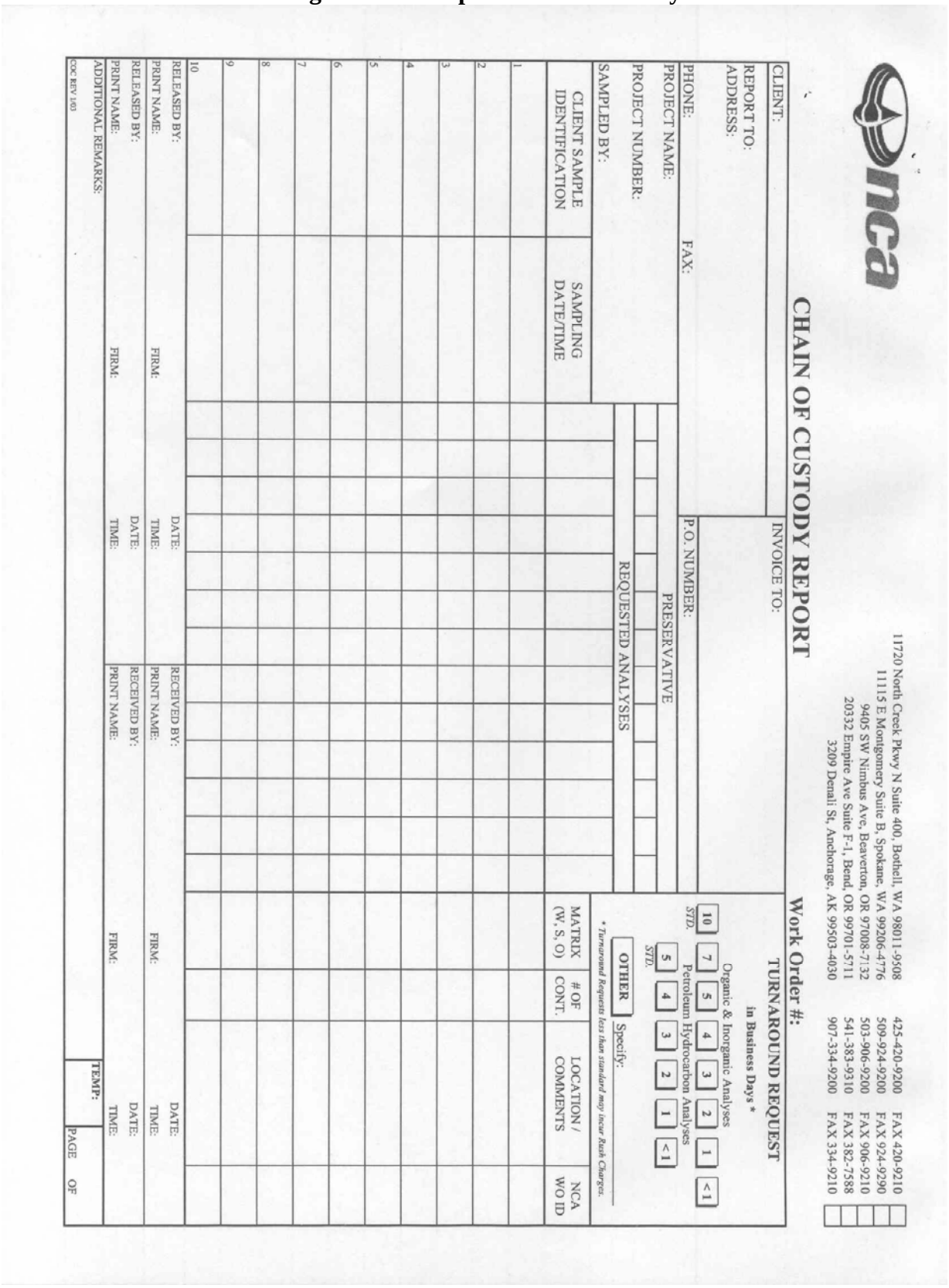


**Figure 6 - Example Chain of Custody**



nca

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-9508 425-420-9200 FAX 420-9210
11115 E Montgomery Suite B, Spokane, WA 99206-4776 509-924-9200 FAX 924-9290
9405 SW Nimbus Ave, Beaverton, OR 97008-7132 503-906-9200 FAX 906-9210
20332 Empire Ave Suite F-1, Bend, OR 99701-5711 541-383-9310 FAX 382-7588
3209 Denali St, Anchorage, AK 99503-4030 907-334-9200 FAX 334-9210

CHAIN OF CUSTODY REPORT

Work Order #:

CLIENT:
REPORT TO:
ADDRESS:
PHONE: FAX:
PROJECT NAME:
PROJECT NUMBER:
SAMPLED BY:
INVOICE TO:
P.O. NUMBER:

TURNAROUND REQUEST
in Business Days *
Organic & Inorganic Analyses
10 7 5 4 3 2 1 <1
STD.
Petroleum Hydrocarbon Analyses
5 4 3 2 1 <1
STD.
OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

PRESERVATIVE
REQUESTED ANALYSES

| | CLIENT SAMPLE IDENTIFICATION | SAMPLING DATE/TIME | MATRIX (W, S, O) | # OF CONT. | LOCATION / COMMENTS | NCA WO ID |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

RELEASED BY: DATE: RECEIVED BY: DATE:
PRINT NAME: TIME: PRINT NAME: TIME:
RELEASED BY: FIRM: DATE: RECEIVED BY: FIRM: DATE:
PRINT NAME: TIME: PRINT NAME: TIME:
ADDITIONAL REMARKS: FIRM: FIRM:

TEMP:

COC REV 1.03

PAGE OF

# Appendices

# Appendix A - Equipment List

| | Inst. ID | Manufacturer | Model# | Description |
|---|---|---|---|---|
| ***Extractions*** | GPC | Analytical Bio-Chemical Laboratories (ABCL) | | |
| | | ABCL | 1101-9077 | Chart Recorder |
| | | ABCL | UVD-1 | UV Detector |
| | | ABCL | 601/602 | Sample Input Module |
| | ASE | Dionex | ASE 200 | PFE |
| | N-EVAP 1 | Organomation | 8125 | N-EVAP |
| | N-EVAP 2 | Organomation | 8125 | N-EVAP |
| | Sonicator 1 | Tekmar | TM375 | Sonicator |
| | Sonicator 2 | Tekmar | TM375 | Sonicator |
| | Sonicator 3 | Tekmar | TM375 | Sonicator |
| | Sonicator 4 | Sonics & Materials | VC375 | Sonicator |
| | SPE | StepSaver | SPE | Filtration Set-Up |
| ***Fuels*** | GC#2 | Hewlett Packard | 5890 Series II | GC/PID/FID |
| | | OI Analytical | 4460 A | Purge & Trap |
| | | OI Analytical | MPM-16/ MHC-16 | Autosampler |
| | GC#4 | Hewlett Packard | 5890 Series II | GC/PID/FID |
| | | Tekmar/Dohrmann | 3100 | Purge & Trap |
| | | Tekmar/Dohrmann | 14-AA70-100 | Autosampler |
| | GC#6 | Hewlett Packard | 5890 Series II | GC/PID/FID |
| | | Tekmar/Dohrmann | 3100 | Purge & Trap |
| | | Tekmar/Dohrmann | 14-AA70-100 | Autosampler |
| | GC#8 | Hewlett Packard | 5890 Series II | GC/PID/FID |
| | | OI Analytical | 4460 A | Purge & Trap |
| | | OI Analytical | MPM-16/ MHC-16 | Autosampler |
| | GC#10 | Hewlett Packard | 5890 Series II | GC/PID/FID |
| | | Tekmar/Dohrmann | 3100 | Purge & Trap |
| | | Tekmar/Dohrmann | 14-AA70-100 | Autosampler |
| | GC#12 | Hewlett Packard | 5890 Series II | GC/PID/FID |
| | | OI Analytical | 4460A | Purge & Trap |
| | | OI Analytical | MPM-16 /MHC-16 | Autosampler |
| | GC#1 | Hewlett Packard | 5890 Series II | GC with dual FID Detectors |
| | GC#3 | Hewlett Packard | 5890E | GC with dual FID Detectors |
| | GC#7 | Hewlett Packard | 5890 Series II | GC with dual FID Detectors |
| | GC#9 | Hewlett Packard | 6890 Series | GC with dual FID Detectors |

## Appendix A - Equipment List (continued)

| | Inst. ID | Manufacturer | Model# | Description |
|---|---|---|---|---|
| ***Organics:*** | ECD 1 | Hewlett | 5890 Series II | GC with dual ECD |
| ***Chlorinated Pesticides*** | | Packard | | Detectors |
| ***PCBs and*** | | | | |
| ***Chlorinated Herbicides*** | ECD 4 | Hewlett | 6890 Series | GC with dual ECD |
| | | Packard | | Detectors |
| | ECD 6 | Hewlett | 6890N | GC with dual ECD |
| | | Packard | | Detectors |
| ***Volatiles*** | MS-1 | Hewlett | 5890 Series II | GC |
| | | Packard | 5970 | MS Detector |
| | | Hewlett | LCS2000 | Concentrator |
| | | Packard | Archon 5100 | Autosampler |
| | | Tekmar | | |
| | | Varian | | |
| | MS-4 | Hewlett | 5890 Series II | GC |
| | | Packard | 5971 | MS Detector |
| | | Hewlett | LSC2000 | Concentrator |
| | | Packard | Archon 5100 | Autosampler |
| | | Tekmar | | |
| | | Varian | | |
| | MS-5 | Hewlett | 5890 Series II | GC |
| | | Packard | 5972 | MS Detector |
| | | Hewlett | LCS2000 | Concentrator |
| | | Packard | Archon 4522 | Autosampler |
| | | Tekmar | | |
| | | Varian | | |
| | MS-10 | Hewlett | 5890 Series II | GC |
| | | Packard | 5970 | MS Detector |
| | | Hewlett | G1900-60500 | Concentrator |
| | | Packard | G1904-60500 | Autosampler |
| | | Hewlett | G1907-60500 | Sample Heater |
| | | Packard | | |
| | | Hewlett | | |
| | | Packard | | |
| | | Hewlett | | |
| | | Packard | | |
| | MS-15 | Hewlett | 6890 Series | GC |
| | | Packard | 5973 | MS Detector |
| | | Hewlett | LCS2000 | Concentrator |
| | | Packard | 14-AA70-100 | Autosampler |
| | | Tekmar | 59822B | Ionization Gauge |
| | | Varian | | Controller |
| | | Hewlett | | |
| | | Packard | | |
| | MS-17 | Agilent | 6890N | GC |
| | | Agilent | 5975 | MS Detector |
| | | Tekmar | 3100 | Concentrator |
| | | Varian | Archon 4522 | Autosampler |

| | | | | |
|---|---|---|---|---|
| ***Semi-Volatiles MS*** | MS-3 | Hewlett Packard | 5890 Series II | GC |
| | | Hewlett Packard | 5971 | MS Detector |
| | MS-7 | Hewlett Packard | 5890 Series II | GC |
| | | Hewlett Packard | 5972 | MS Detector |
| | MS-9 | Hewlett Packard | 6890 Series | GC |
| | | Hewlett Packard | 5973 | MS Detector |
| | MS-11 | Hewlett Packard | 6890 Series | GC |
| | | Hewlett Packard | 5973 | MS Detector |
| | MS-14 | Agilent | 6890 Series | GC |
| | | Agilent | 5973 | MS Detector |
| | MS-16 | Agilent | 6890 Series | GC |
| | | Agilent | 5973 | MS Detector |

## Appendix A - Equipment List (continued)

| | Inst. ID | Manufacturer | Model# | Description |
|---|---|---|---|---|
| ***Inorganics*** | TOC-1 | Teledyne Tekmar | Apollo 9000 | TOC Analyzer |
| | | Teledyne Tekmar | | Autosampler |
| | | Rosemount Dohrman | | TOC Boat Sampler |
| | IC-1 | Dionex | DX-100 | IC |
| | IC-2 | Dionex | DX-500 | IC |
| | UV-VIS#1 | Spectronic | 20 Genesys | UV-VIS |
| | UV-VIS#2 | Perkin Elmer | Lambda 3B | UV-VIS |
| | UV-VIS#3 | Shimadzu | UV160U | UV-VIS |
| | Lachat | Lachat | 8000 | Flow Analyzer |
| | | Lachat | ASX-500 | Autosampler |
| | Hach | Hach | 2100N | Turbidimeter |
| | pH | Accumet | | pH Meter |
| | TKN Block Digestor | A.I. Scientific | AIM500-C | TKN Block Digestor |
| | ICP-1 | TJA | ICAP 61E Purge | ICP |
| | ICP-2 | TJA | ICAP 61E Trace Purge | ICP |
| | CVAF | PSA | Millennium 10.0 | CVAF |
| | ICP/MS-1 | Hewlett Packard | 4500 | ICP/MS |
| | ICP/MS-2 | Hewlett Packard | 7500 | ICP/MS |

### 1.2 Seattle Accreditations and Method Capabilities

| Test Code | WDOE/WDOH | A2LA | NELAP CA | NELAP UT | Navy | AK | ID | MT | CO |
|---|---|---|---|---|---|---|---|---|---|
| **Expiration date:** | **6/30/2007** | **8/31/2006** | **1/31/2007** | **1/31/2007** | **6/9/2007** | **12/26/2006** | **6/30/2007** | **4/30/2007** | **3/31/2007** |
| **1658 Herbicides** | | | | | | | | | |
| **524.2 Volatiles** | | | | | | | | | |
| **615 Herb** | | | | | | | | | |
| **8015B TPH-DRO/GRO** | HW | WW | HW | HW | W/S | | | | |
| **8021B (BTEX)** | HW | WW,HW | HW | HW | W/S | W (BETX) | | | |
| **8021B (MN)** | | | HW | HW | | | | | |
| **8081A Pesticides** | HW | WW,HW | HW | HW | W/S | | | | |
| **8082 PCB Aroclors** | HW | WW,HW | HW | HW | W/S | W/S | | | |
| **8082 Mod PCB Only** | HW | WW,HW | | | | | | | |
| **8082 PCB Congeners** | | WW,HW | | | | | | | |
| **8151A/8151A Herb** | HW | WW,HW | HW | HW | W/S | | | | |
| **8260B VOA Full List** | HW | WW,HW | HW | HW | W/S | W/S | | | |
| **8270C SVOA Full List** | HW | WW, HW | HW | HW | W/S | | | | |
| **Acidity-305.1** | WW | DW,WW | WW | WW | | | | | |
| **Acidity-SM2310B** | WW | DW,WW | WW | WW | | | | | |
| **Ag ICP 200.7** | DW, WW | DW, WW | WW | WW | | | | | |
| **Ag ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Ag ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | | | |
| **Ag ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |
| **AK 101 AA** | | WW,HW | | | | | | | |
| **AK101 (GRO)** | | WW,HW | | | | W/S | | | |
| **AK102 (DRO)** | | WW,HW | | | | W/S | | | |
| **AK102 (DRO) SV** | | WW,HW | | | | W/S | | | |
| **AK102AA** | | WW,HW | | | | | | | |
| **AK103 (RRO)** | | WW,HW | | | | S | | | |
| **AK103AA** | | WW,HW | | | | | | | |
| **Al ICP 200.7** | DW, WW | DW,WW | WW | WW | | | | | |
| **Al ICP 6010B** | HW | HW | | | W/S | | | | |
| **Al ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | | | |
| **Al ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Alkalinity 310.1** | WW | DW,WW | WW | WW | | | | | |
| **Alkalinity-SM2320B** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **Ammonia SM4500-N** | WW | DW,WW | WW | WW | | | | | |
| **Ammonia-350.3** | WW | DW,WW,HW | WW | WW | | | | | |
| **As ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **As ICP 6010B** | HW | HW | HW | HW | W/S | W/S | | | |
| **As ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **As ICPMS 6020** | HW | HW | HW | HW | W/S | W/S | | | |
| **Au ICPMS 200.8** | | | | | | | | | |
| **Au ICP 6020** | HW | HW | | | | | | | |
| **B ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **B ICP 6010B** | HW | HW | | | W/S | | | | |
| **B ICPMS 200.8** | WW | DW, WW | | | | | | | |
| **B ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Ba ICP 200.7** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **Ba ICP 6010B** | HW | HW | HW | HW | W/S | W/S | | | |
| **Ba ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **Ba ICPMS 6020** | HW | HW | HW | HW | W/S | W/S | | | |

## 1.2 Seattle Accreditations and Method Capabilities

| Test Code | WDOE/WDOH | A2LA | NELAP CA | NELAP UT | Navy | AK | ID | MT | CO |
|---|---|---|---|---|---|---|---|---|---|
| **Expiration date:** | **6/30/2007** | **8/31/2006** | **1/31/2007** | **1/31/2007** | **6/9/2007** | **12/26/2006** | **6/30/2007** | **4/30/2007** | **3/31/2007** |
| **Be ICP 200.7** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **Be ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Be ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **Be ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |
| **BOD SM5210** | | | | | | | | | |
| **BOD405.1/5210B** | WW | DW,WW | WW | WW | | | | | |
| **CBOD405.1/5210B** | WW | DW,WW | WW | WW | | | | | |
| **Bromide-300.0** | WW,HW | WW,HW | WW | WW | | | | | |
| **Bromide-SM4110B** | WW | WW | | | | | | | |
| **Bromide-9056** | HW | HW | | | | | | | |
| **Ca ICP 200.7** | DW,WW | DW,WW | WW | WW | | | DW | | |
| **Ca ICP 6010B** | HW | HW | | | W/S | | | | |
| **Ca ICPMS 200.8** | WW | DW, WW | | | | | | | |
| **Ca ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Cd ICP 200.7** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **Cd ICP 6010B** | HW | HW | HW | HW | W/S | W/S | | | |
| **Cd ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **Cd ICPMS 6020** | HW | HW | HW | HW | W/S | W/S | | | |
| **Chloride-300.0** | DW,WW,HW | DW,WW, HW | WW | WW | W | | | | |
| **Chloride-SM4110B** | DW, WW | DW, WW | | | | | | | |
| **Chloride-9056** | HW | HW | | | W | | | | |
| **Cl Residual SM4500CL G** | DW, WW | DW,WW | WW | WW | | | | | |
| **Cl Residual-330.5** | DW, WW | DW,WW | WW | WW | | | | | |
| **Co ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **Co ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Co ICPMS 200.8** | WW | DW, WW | WW | WW | | | | | |
| **Co ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |
| **COD SM5220D** | WW | DW,WW | WW | WW | | | | | |
| **COD-410.4** | WW | DW,WW | WW | WW | | | | | |
| **Color-110.2** | WW | DW,WW | WW | WW | | | | | |
| **Color-SM2120B** | DW, WW | DW,WW | WW | WW | | | | | |
| **Conductivity-120.1** | DW,WW | DW,WW | WW | WW | | | | | |
| **Conductivity-9050A** | WW | WW | | | | | | | |
| **Conductivity-SM2510B** | DW,WW,HW | DW,WW,HW | WW | WW | | | DW | | |
| **Corrosivity (coupon)** | | | | | | | | | |
| **Corrosivity-9040B** | | | HW | HW | | | | | |
| **Corrosivity-9045C** | | | HW | HW | | | | | |
| ***CNAMEN335.14500CNG*** | | DW,WW | WW | WW | | | | | |
| **Cr ICP 200.7** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **Cr ICP 6010B** | HW | HW | HW | HW | W/S | W/S | | | |
| **Cr ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **Cr ICPMS 6020** | HW | HW | HW | HW | W/S | W/S | | | |
| **Cr6, Solid 3060A/7196A** | | HW | HW | HW | S | | | | |
| **Cr6, Solid 3060A/6010B** | HW | HW | | | | | | | |
| **Cr6, EPA 7195** | | | | | | | | | |
| **Cr6, Aqueous 7196A** | HW | DW,WW | HW | HW | W | | | | |
| **Cr6, Aqueous SM3500Cr** | WW | DW,WW | WW | WW | | | | | |

## 1.2 Seattle Accreditations and Method Capabilities

| Test Code | WDOE/WDOH | A2LA | NELAP CA | NELAP UT | Navy | AK | ID | MT | CO |
|---|---|---|---|---|---|---|---|---|---|
| **Expiration date:** | **6/30/2007** | **8/31/2006** | **1/31/2007** | **1/31/2007** | **6/9/2007** | **12/26/2006** | **6/30/2007** | **4/30/2007** | **3/31/2007** |
| **Cu ICP 200.7** | DW, WW | DW,WW | WW | WW | | | | | |
| **Cu ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Cu ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **Cu ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |
| **Cyanide - SM4500CN E** | DW, WW | DW,WW | WW | WW | | | DW | | DW |
| **Cyanide WAD 4500CN-I** | WW | DW,WW | | | | | | | |
| **Cyanide, Amen-SM4500-CN G** | WW | DW,WW | WW | WW | | | | | |
| **Cyanide, Amen-9010C** | | HW | | | | | | | |
| **Cyanide, Amen-335.1** | WW | DW,WW | WW | WW | | | | | |
| **Cyanide, Total-335.2/335.4** | DW,WW | DW,WW | WW | WW | | | | | |
| **Cyanide, Total-9010A** | | | | | | | | | |
| **Cyanide, Total-9010C** | | HW | | | W | | | | |
| **Cyanide, Total-9013** | | HW | | | | | | | |
| **Cyanide, Amen-9012** | HW | | | | | | | | |
| **Cyanide, Total-9014** | HW | HW | HW | HW | | | | | |
| **Dioxane** | | WW,HW | | | | | | | |
| **DO-360.1/4500-O G** | WW | DW,WW | WW | WW | | | | | |
| **DO-360.2/4500-O BC** | WW | DW,WW | WW | WW | | | | | |
| **DOC-415.1/SM5310B** | WW | DW,WW | | | | | | | |
| **EDB/DBCP-8011** | HW | WW,HW | HW | HW | | | | | |
| **EOX-9023** | | | | | | | | | |
| **EPA 1631 Modified** | | | | | | | | | |
| **EPA 608 NPDES** | WW | WW | WW | WW | | | | | |
| **EPA 615 Modified** | | | | | | | | | |
| **EPA 624 NPDES** | WW | WW | WW | WW | | | | | |
| **EPA 625 NPDES** | WW | WW | WW | WW | | | | | |
| **FC MF-SM9222** | DW, WW | DW,WW | WW | WW | | | | | |
| **FC MPN-SM9221** | DW, WW | DW,WW, HW (9221E) | WW | WW | | | | | |
| **Fe ICP 200.7** | DW, WW | DW,WW | WW | WW | | | | | |
| **Fe ICP 6010B** | HW | HW | | | W/S | | | | |
| **Fe ICPMS 200.8** | WW | DW, WW | | | | | | | |
| **Fe ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Fe(+3)6010BSM3500FeD** | WW | DW,WW | | | | | | | |
| **Ferrous Iron** | WW | DW,WW | | | | | | | |
| **Fluoride-300.0** | DW,WW,HW | DW, WW,HW | WW | WW | W | | DW | | DW |
| **Fluoride-SM4110B** | DW,WW | DW,WW | | | | | | | |
| **Fluoride-9056** | HW | HW | HW | HW | W | | | | |
| **Fluoride-340.2** | WW | WW | HW | HW | | | | | |
| **Fluoride-SM4500-F C** | DW,WW | DW,WW | WW | WW | | | | | |
| **GCMS-SIM PAH** | HW | HW | | | | W/S | | | |
| **Hardness SM2340B** | DW, WW | DW,WW | WW | WW | | | | | |
| **Hardness-SM2340C** | WW | DW,WW | WW | WW | | | | | |
| **Hardness-130.2** | WW | DW,WW | WW | WW | | | | | |
| **Hg Total 7470/7471** | HW | HW | HW | HW | W/S | | | | |
| **Hg Total CVAA 245.1** | DW, WW | DW,WW | WW | WW | | | DW | | DW |
| **Hg Total SM3112B** | DW, WW | DW,WW | WW | WW | | | | | |

### 1.2 Seattle Accreditations and Method Capabilities

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|---|---|---|---|---|---|---|---|---|---|
| **Expiration date:** | **6/30/2007** | **8/31/2006** | **1/31/2007** | **1/31/2007** | **6/9/2007** | **12/26/2006** | **6/30/2007** | **4/30/2007** | **3/31/2007** |
| **K ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **K ICP 6010B** | HW | HW | | | W/S | | | | |
| **K ICPMS 200.8** | WW | DW, WW | | | | | | | |
| **K ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Li ICPMS 200.8** | | | | | | | | | |
| **Li ICPMS 6020** | HW | HW | | | | | | | |
| **MBAS-425.1** | WW | DW,WW | WW | WW | | | | | |
| **MBAS-SM5540C** | DW,WW | DW,WW | WW | WW | | | | | |
| **Mg ICP 200.7** | DW,WW | DW,WW | WW | WW | | | | | |
| **Mg ICP 6010B** | HW | HW | | | W/S | | | | |
| **Mg ICPMS 200.8** | WW | DW, WW | | | | | | | |
| **Mg ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Mn ICP 200.7** | DW, WW | DW,WW | WW | WW | | | | | |
| **Mn ICP 6010B** | HW | HW | | | W/S | | | | |
| **Mn ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | | | |
| **Mn ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Mo ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **Mo ICP 6010B** | HW | HW | HW | HW | | | | | |
| **Mo ICPMS 200.8** | WW | DW, WW | WW | WW | | | | | |
| **Mo ICPMS 6020** | HW | HW | HW | HW | | | | | |
| **MT - EPH** | | WW,HW | | | | | | X | |
| **MT - VPH** | | WW,HW | | | | | | X | |
| **MTCA-EPH** | HW | WW,HW | | | | | | | |
| **MTCA-VPH** | HW | WW,HW | | | | | | | |
| **MTTPH-Dext** | | WW,HW | | | | | | | |
| **MTTPH-G** | | WW,HW (as Gx) | | | | | | | |
| **Na Total ICP 200.7** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **Na Total ICP 6010B** | HW | HW | | | W/S | | | | |
| **Na Total ICPMS 200.8** | WW | DW, WW | | | | | | | |
| **Na Total ICPMS 6020** | HW | HW | | | W/S | | | | |
| **Ni Total ICP 200.7** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **Ni Total ICP 6010B** | HW | HW | HW | HW | W/S | W/S | | | |
| **Ni Total ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **Ni Total ICPMS 6020** | HW | HW | HW | HW | W/S | W/S | | | |
| **Nitrate-300.0** | DW,WW,HW | DW,WW,HW | WW | WW | W | | DW | | DW |
| **Nitrate-SM4110B** | DW, WW | DW, WW | | | | | | | |
| **Nitrate-353.2** | WW | DW,WW | WW | WW | W | | | | |
| **Nitrate-9056** | HW | HW | | | W | | | | |
| **Nitrite-300.0** | DW,WW,HW | DW,WW,HW | WW | WW | W | | DW | | DW |
| **Nitrite-353.2** | WW | DW,WW | WW | WW | W | | | | |
| **Nitrite-SM4110B** | DW, WW | DW, WW | | | | | | | |
| **Nitrite-9056** | HW | HW | | | W | | | | |
| **NO2-NO3 353.2** | WW | DW,WW,HW | WW | WW | | | | | |
| **NO2-NO3 SM4500NO3 I** | | DW,WW | | | | | | | |
| **NWTPH-Dx** | HW (and 8015) | WW,HW | | | | | | | |
| **NWTPH-Gx** | HW (and 8015) | WW,HW | | | | | | | |
| **NWTPH-HCID** | | WW,HW | | | | | | | |

### 1.2 Seattle Accreditations and Method Capabilities

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|---|---|---|---|---|---|---|---|---|---|
| **Expiration date:** | **6/30/2007** | **8/31/2006** | **1/31/2007** | **1/31/2007** | **6/9/2007** | **12/26/2006** | **6/30/2007** | **4/30/2007** | **3/31/2007** |
| **O&G FOG** | | | WW | WW | | | | | |
| **O&G-1664 HEM Only** | WW | DW,WW | WW | WW | | | | | |
| **O&G-1664 HEM/SGT** | WW | | WW | WW | | | | | |
| **O&G-1664 SGT Only** | WW | | WW | WW | | | | | |
| **O&G-9071A** | | HW(as 9070A) | | | | | | | |
| **O&G-9071A w/SGT** | HW | | | | | | | | |
| **Orthophospate-300.0** | | | | | | | | | |
| **Orthophospate-9056** | HW | HW | | | W | | | | |
| **Orthophospate-SM4110B** | WW | WW | | | W | | | | |
| **Orthophosphate 365.2** | WW | DW,WW | WW | WW | | | | | |
| **P Soluble 365.2** | WW | | | | | | | | |
| **P Total Color 365.2** | WW | DW,WW | WW | WW | | | | | |
| **P Total ICP 200.7** | WW | DW,WW | | | | | | | |
| **P Total ICP 6010B** | | | | | | | | | |
| **Paint Filter-9095** | HW | HW | | | | | | | |
| **Pb Total ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **Pb Total ICP 6010B** | HW | HW | HW | HW | W/S | W/S | | | |
| **Pb Total ICPMS 200.8** | DW, WW | DW, WW | WW | WW | | | DW | | DW |
| **Pb Total ICPMS 6020** | HW | HW | HW | HW | W/S | W/S | | | |
| **pH-150.1** | DW, WW | DW,WW | WW | WW | | | DW | | |
| **pH-SM4500H+B** | | | WW | WW | | | | | |
| **pH-9040B** | HW | HW | HW | HW | | | | | |
| **pH-9045** | HW | | HW | HW | HW | | | | |
| **pH-9045B** | | HW(as 9045C) | | | | | | | |
| **Phenols-420.1** | WW | DW,WW | WW | WW | | | | | |
| **Phenols-9065** | HW | HW | | | | | | | |
| **Phos-Ortho SM4500-P** | DW,WW | DW,WW | WW | WW | | | | | |
| **Phos-Total SM4500-P** | WW | DW,WW | WW | WW | | | | | |
| **Plate Count-SM9215** | DW,WW | DW,WW | WW | WW | | | | | |
| **Reactive Sulfide** | | | | | | | | | |
| **Salinity-SM2520B** | WW | DW,WW | | | | | | | |
| **Sb Total ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **Sb Total ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Sb Total ICPMS 200.8** | DW,WW | DW, WW | | | | | DW | | DW |
| **Sb Total ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |
| **Se Total ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **Se Total ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Se Total ICPMS 200.8** | DW,WW | DW, WW | WW | WW | | | DW | | DW |
| **Se Total ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |
| **Si ICP 200.7** | | DW(200.8also)WW | WW | WW | | | | | |
| **Si ICP 6010B** | | HW(6020 also) | | | | | | | |
| **SiO2 Colorimetric** | DW,WW (as SM4500-Si D) | DW,WW | WW | WW | | | DW | | |

## 1.2 Seattle Accreditations and Method Capabilities

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|---|---|---|---|---|---|---|---|---|---|
| **Expiration date:** | **6/30/2007** | **8/31/2006** | **1/31/2007** | **1/31/2007** | **6/9/2007** | **12/26/2006** | **6/30/2007** | **4/30/2007** | **3/31/2007** |
| **Sn TCLP ICPMS 6020** | | | | | | | | | |
| **Sn Total ICP 200.7** | WW | DW, WW | WW | WW | | | | | |
| **Sn Total ICP 6010B** | HW | HW | | | W/S | | | | |
| **Sn Total ICP 200.8** | WW | DW, WW | | | | | | | |
| **Sn Total ICP 6020** | HW | HW | | | W/S | | | | |
| **Solids, Sttbl-160.5** | | DW,WW | WW | WW | | | | | |
| **Solids, Sttbl-SM2540F** | | | WW | WW | | | | | |
| **Solids, TDS-160.1** | WW | DW,WW | WW | WW | | | | | |
| **Solids, TDS-SM2540C** | DW,WW | DW,WW | WW | WW | | | | | |
| **Solids, Total-160.3** | WW | DW,WW | WW | WW | | | | | |
| **Solids, Total-SM2540B** | WW | DW,WW | WW | WW | | | | | |
| **Solids, TSS-160.2** | WW | DW, WW | WW | WW | | | | | |
| **Solids, TSS-SM2540D** | WW | DW,WW | WW | WW | | | | | |
| **Solids, TVS-160.4** | WW | DW,WW | WW | WW | | | | | |
| **Solids, TVS-SM2540E** | WW | DW,WW | | | | | | | |
| **Sp. Gravity D287** | | | | | | | | | |
| **Sp. Gravity-SM2710F** | | | | | | | | | |
| **SPLP Extraction** | | HW | HW | HW | | | | | |
| **Sr ICPMS 200.8** | WW | DW,WW | | | | | | | |
| **Sr ICPMS 6020** | HW | HW | | | W/S | | | | |
| **STLC Extraction** | | | HW | HW | | | | | |
| **Sulfate-300.0** | DW,WW,HW | DW,WW,HW | WW | WW | W | | | | |
| **Sulfate-9056** | HW | HW | | | W | | | | |
| **Sulfate-SM4110B** | | DW,WW | | | | | | | |
| **Sulfide-376.1** | WW | DW,WW | WW | WW | | | | | |
| **Sulfide-376.2** | WW | DW,WW | WW | WW | | | | | |
| **Sulfide-9030B** | HW | HW | | | | | | | |
| **Sulfide-9034** | HW | HW | | | | | | | |
| **Sulfite-377.1** | WW | DW,WW | | | | | | | |
| **TC MF-SM9222** | DW,WW | WW, DW (9222B) | WW | WW | | | | | |
| **TC MPN-SM9221** | DW,WW | WW, DW & HW | WW | WW | | | | | |
| **TC P/A-SM9223** | DW (colilert&colisure) | DW,WW (colilert&colisure) | | | | | | | |
| **TCLP Extraction** | | HW | | | | | | | |
| **TCLP/ZHE Extraction** | | HW | HW | HW | | | | | |
| **Th Total ICPMS 6020** | | DW,WW | | | | | | | |
| **Ti Total ICP 200.7** | WW | DW,WW | | | | | | | |
| **Ti Total ICP 6010B** | HW | HW | | | W/S | | | | |
| **Ti Total ICPMS 200.8** | WW | DW, WW | | | | | | | |
| **Ti Total ICPMS 6020** | HW | HW | | | W/S | | | | |
| **TKN-351.2** | WW | DW,WW | WW | WW | | | | | |
| **TKN-SM4500Norg D** | WW | DW,WW | | | | | | | |
| **Tl Total ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **Tl Total ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Tl Total ICPMS 200.8** | DW,WW | DW, WW | WW | WW | | | DW | | DW |
| **Tl Total ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |

### 1.2 Seattle Accreditations and Method Capabilities

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|---|---|---|---|---|---|---|---|---|---|
| **Expiration date:** | **6/30/2007** | **8/31/2006** | **1/31/2007** | **1/31/2007** | **6/9/2007** | **12/26/2006** | **6/30/2007** | **4/30/2007** | **3/31/2007** |
| **TOC (4) EPA 9060** | HW | HW | | | | | | | |
| **TOC,415.1 5310B** | DW,WW | DW,WW | WW | WW | | | | | DW |
| **TOX - SM 5320B** | | | | | | | | | |
| **TOX-9020** | | | | | | | | | |
| **TOX-9020B** | | | | | | | | | |
| **Turbidity180.1/2130B** | DW,WW | DW,WW | WW | WW | | | DW | | |
| **TX-9076** | | | | | | | | | |
| **U 200.8** | DW,WW | | | | | | | | |
| **U ICPMS 6020** | HW | HW | | | | | | | |
| **V Total ICP 200.7** | WW | DW,WW | WW | WW | | | | | |
| **V Total ICP 6010B** | HW | HW | HW | HW | W/S | W/S | | | |
| **V Total ICPMS 200.8** | WW | DW, WW | WW | WW | | | | | |
| **V Total ICPMS 6020** | HW | HW | HW | HW | W/S | W/S | | | |
| **Zn Total ICP 200.7** | DW,WW | DW,WW | WW | WW | | | | | |
| **Zn Total ICP 6010B** | HW | HW | HW | HW | W/S | | | | |
| **Zn Total ICPMS 200.8** | DW,WW | DW, WW | WW | WW | | | | | |
| **Zn Total ICPMS 6020** | HW | HW | HW | HW | W/S | | | | |
| **Zr Total ICP 6010B** | | | | | | | | | |

**W = water**
**S = solid**
**DW/PW = drinking water**
**WW/NonPotable = wastewater**
**HW = Hazardous Waste (not aqueous)**

# Appendix C - SOP Summary and Link to NELAC Standard

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| SOP No. | Title | NELAC Link |
|---|---|---|
| B-SOP-CP01-06 | Internal Investigation of Potential Data Discrepancies and Determination for Data Recall | Section 5.4.9<br>Section 5.4.15 |
| B-SOP-DII-001 | Data Integrity and Ethical Practices Policy | Section 5.5.2.7 |
| B-SOP-DII-002 | Proper Manual Integration Procedures | Section 5.5.2.7 |
| B-SOP-DII-003 | Basic Employee Training | Section 5.5.2.6 |
| B-SOP-DII-006 | Internal and External Monitoring Systems | Section 5.5.2.7 |
| B-SOP-EXT-001 | Preparation of Soils and Solids for Semi-Volatile Analysis by EPA 3550B (Sonication) | Appendix D1 |
| B-SOP-EXT-002 | Waste Extraction Test (WET) California Environmental Health Standards 66261.126 | Appendix D1 |
| B-SOP-EXT-003 | Preparation of Liquids for Semi-Volatile Analysis by EPA 3520C Liquid/Liquid Extraction | Appendix D1 |
| B-SOP-EXT-004 | Standard Operating Procedure: Toxicity Characteristic Leaching Procedure (TCLP), EPA 1311 | Appendix D1 |
| B-SOP-EXT-005 | N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) in Soil, Sludge and Sediment Samples by EPA 9071B Mod | Appendix D1 |
| B-SOP-EXT-006 | Preparation of Solids for Semi-Volatile Analysis by EPA 3540C Liquid/Solid Extraction | Appendix D1 |
| B-SOP-EXT-007 | Preparation of Liquids for Semi-Volatile Analysis by EPA 3510C Liquid/Liquid Extraction | Appendix D1 |
| B-SOP-EXT-010 | Oil and Grease by EPA 1664, N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) | Appendix D1 |
| B-SOP-EXT-011 | Chlorinated Herbicides: Preparation of Waters, Soils and Wastes By EPA 8151A | Appendix D1 |
| B-SOP-EXT-012 | Aliphatic/Aromatic Fractionation Procedure by Column Chromatography | Appendix D1 |
| B-SOP-EXT-013 | Standard Operating Procedure for WTPH and NWHCID for Soils and Solids | Appendix D1 |
| B-SOP-EXT-014 | Preparation of Wipes for PCB Analysis by EPA 8082 | Appendix D1 |
| B-SOP-EXT-015 | EPA 3580A: Waste Dilutions | Appendix D1 |
| B-SOP-EXT-016 | EPA Method 3665A: PCB Acid Clean Up Procedure | Appendix D1 |
| B-SOP-EXT-017 | Silica Gel/Acid Cleanup | Appendix D1 |
| B-SOP-EXT-018 | Preparation of Solids for Semi-Volatile Analysis by Pressurized Fluid Extraction (EPA 3545) | Appendix D1 |
| B-SOP-EXT-019 | Florisil Cartridge Cleanup of Extracts for Pesticide Analysis | Appendix D1 |
| B-SOP-EXT-020 | Homogenization and Subsampling of Laboratory Samples | Appendix D1 |
| B-SOP-EXT-022 | Extraction of PCBs in Aqueous Samples Using a Micro-Extraction Technique Followed by Gas Chromatography Analysis Utilizing an Electron Capture Detector (EPA 8082 Modified) | Appendix D1 |

# Appendix C - SOP Summary and Link to NELAC Standard

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| SOP No. | Title | NELAC Link |
|---|---|---|
| B-SOP-EXT-023 | Extraction of Chlorinated Pesticides in Aqueous Samples Using a Micro-Extraction Technique Followed by Gas Chromatography Analysis Utilizing an Electron Capture Detector (EPA 8081A Modified) | Appendix D1 |
| B-SOP-EXT-024 | Extraction of TPH in Aqueous Samples Using a Micro-Extraction Technique Followed by Gas Chromatography Analysis Utilizing a Flame Ionization Detector (AK102/103) | Appendix D1 |
| B-SOP-FLS-004 | Measurement of Gasoline Range Hydrocarbons (GRO) by Gas Chromatography FID/PID (GC FID/PID) in Series: AK 101 | |
| B-SOP-FLS-005 | Measurement of Aliphatic and Aromatic Hydrocarbons in Residual Range Organics (RRO) by Gas Chromatography/FID (GC/FID): AK 102 | |
| B-SOP-FLS-006 | Measurement of Volatile Organics Compounds in Gasoline by Gas Chromatography PID (GC/PID): EPA 8021B | Appendix D1 |
| B-SOP-FLS-007 | Determination of Gasoline Range Hydrocarbons (GRO) by Gas Chromatography (GC) with FID/PID Detection | Appendix D1 |
| B-SOP-FLS-008 | Method for the Determination of Volatile Petroleum Hydrocarbons (VPH): Washington VPH | |
| B-SOP-FLS-009 | Semi-Volatile Hydrocarbons By GC/FID | Appendix D1 |
| B-SOP-FLS-010 | Semi-Volatile Hydrocarbon Analysis by Washington EPH | |
| B-SOP-FLS-011 | Semi-Volatile Hydrocarbon Analysis by Montana EPH | |
| B-SOP-FLS-012 | Method for the Determination of Volatile Petroleum Hydrocarbons (VPH): Montana VPH | |
| B-SOP-FLS-013 | Operation of the ToxiRAE PID for the Prescreening of Soil Samples for Gas/BTEX Analysis | |
| B-SOP-FLS-014 | Operation of the Tekmar 3100/AQUA Tek 70 P/T Autosamplers for the Determination of Volatile Organic Compounds and Gasoline Range Hydrocarbons by GC/FID/PID | |
| B-SOP-ISG-001 | Information Systems Hardware Audits | Section 5.4.12 |
| B-SOP-ISG-002 | Software Validation and Control | Section 5.4.12 |
| B-SOP-ISG-003 | Storage and Security of Computer Programs and Electronic Data | Section 5.4.12 |
| B-SOP-ISG-004 | Software Installation and Configuration | Section 5.4.12 |
| B-SOP-MIC-001 | Preparation of Culture Media | Section 5.5.6, Appendix D3 |
| B-SOP-MIC-002 | Heterotrophic Plate Count - SM 9215 (Pour Plate Method) | Appendix D3 |
| B-SOP-MIC-003 | Colilert P/A and Colisure P/A - SM 9223 Presence/Absence Coliform Test | Appendix D3 |
| B-SOP-MIC-004 | Membrane Filter (MF) Technique for Total Coliforms in Water (SM 9222B) | Appendix D3 |
| B-SOP-MIC-005 | Membrane Filter (MF) Technique for Fecal Coliforms in Water (SM 9222D) | Appendix D3 |
| B-SOP-MIC-006 | Multiple Tube Fermentation Technique (MPN) for Total Coliforms (SM 9221B) | Appendix D3 |

# Appendix C - SOP Summary and Link to NELAC Standard

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| SOP No. | Title | NELAC Link |
|---|---|---|
| B-SOP-MIC-007 | Multiple Tube Fermentation (MPN) Technique for Fecal Coliforms and Escherichia Coli (SM 9221E, 9221F) | Appendix D3 |
| B-SOP-MIC-008 | Soil and Compost Extraction for MPN Analysis | Appendix D3 |
| B-SOP-MIC-009 | Salmonella in Composts | Appendix D3 |
| B-SOP-MIC-010 | Microbiology - Specific QA/QC | Section 5.7.1(c) Appendix D3 |
| B-SOP-MTL-001 | Mercury in Water by EPA 245.1 and 7470A, and Solid Matrices by EPA 7471A Manual Cold Vapor Technique (CVAA) | Section 5.5.6, Appendix D1 |
| B-SOP-MTL-002 | Determination of Total and Dissolved Trace Elements in Liquids, Solids and Wastes - EPA 200.7 and 6010B (Inductively Coupled Plasma) | Section 5.5.6, Appendix D1 |
| B-SOP-MTL-003 | Determination of Total and Dissolved Trace Elements in Liquids, Solids, and Wastes - EPA 200.8 and 6020 (Inductively Coupled Plasma Mass Spectroscopy) | Section 5.5.6, Appendix D1 |
| B-SOP-MTL-004 | Acid Digestion for Total Recoverable or Dissolved Metals for Analysis by ICP or ICPMS (EPA 3005A) | Appendix D1 |
| B-SOP-MTL-006 | Strong Acid Digestion of Solid Samples for Recoverable Metals for Analysis by ICP or ICPMS (EPA 3050B) | Appendix D1 |
| B-SOP-MTL-007 | Acid Digestion of Aqueous Samples for Total Metals for Analysis by ICPMS (EPA 3020A) | Appendix D1 |
| B-SOP-MTL-008 | Acid Digestion of Aqueous Samples for Total Metals for Analysis by ICP and ICPMS (EPA 3010A) | Appendix D1 |
| B-SOP-MTL-009 | Preparation of Aqueous Samples for Dissolved, Suspended, Total and Total Recoverable Metals (EPA 200.7) | Appendix D1 |
| B-SOP-MTL-010 | Acid Digestion of Biological Tissues for Total Recoverable Metals Determination EPA 200.3 | Appendix D1 |
| B-SOP-MTL-011 | Preparation of Aqueous Samples for Dissolved and Total Recoverable Metals (EPA 200.8) | Appendix D1 |
| B-SOP-MTL-012 | Alkaline Digestion of Soil, Sediments and Solids for Hexavalent Chromium (EPA 3060A) | Appendix D1 |
| B-SOP-ORG-001 | Analysis of Volatile Organic Compounds by Method 8260B Utilizing Purge and Trap Gas Chromatographic/Mass Spectrometry | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-002 | Analysis of Semi-Volatile Organic Compounds by Method 8270C Utilizing Gas Chromatography/Mass Spectrometry | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-003 | Analysis of Chlorinated Pesticides by Method 8081A Utilizing Gas Chromatography with an Electron Capture Detection (GC/ECD) | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-004 | Analysis of Chlorinated Herbicides by Method 8151A Utilizing Gas Chromatography with an Electron Capture Detection (GC/ECD) | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-005 | Analysis of Polychlorinated Biphenyls (PCBs) by Method 8082 Utilizing Gas Chromatography with an Electron Capture Detection (GC/ECD) | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-007 | Analysis of Volatile Organic Compounds by Method 624 Utilizing Purge and Trap Gas Chromatographic/Mass Spectrometry | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-008 | Analysis of Organochlorine Pesticides and PCBs by Method 608 Utilizing Gas Chromatography with an Electron Capture Detection (GC/ECD) | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-009 | Analysis of Semi-Volatile Organic Compounds by Method 625 Utilizing Gas Chromatography/Mass Spectrometry | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-012 | Measurement of 1,4-Dioxane in Aqueous Samples by GC/MS-SIM | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-013 | Measurement of Semi-Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry using Selected Ion Monitoring (Method 8270C Modified) | Section 5.5.6, Appendix D1 |

# Appendix C - SOP Summary and Link to NELAC Standard

| SOP No. | Title | NELAC Link |
|---|---|---|
| B-SOP-ORG-014 | Measurement of EBD and DBCP in Aqueous Matrices Utilizing Micro-extraction and Gas Chromatography with an Electron Capture Detector (GC/ECD) | Section 5.5.6, Appendix D1 |
| B-SOP-ORG-015 | Measurement of Semi-Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry using High Volume Injection (Method 8270C Modified) | Section 5.5.6, Appendix D1 |
| B-SOP-PMG-001 | Project Management Roles and Responsibilities | Section 5.4.2.3, 5.4.8 |
| B-SOP-PMG-002 | Contingency Analysis | Section 5.4.5 |
| B-SOP-PMG-003 | Correcting Defective Reports and Issuing Amended Reports | Section 5.5.10 |
| B-SOP-QAG-001 | Control of the Laboratory's Quality System Documents | Section 5.4.3 |
| B-SOP-QAG-003 | Audits and Proficiency Testing | Section 5.4.2.6 5.4.13 |
| B-SOP-QAG-004 | Determining and Verifying Method Detection Limits (MDL) and Establishing Method Reporting Limits (MRL) | Section 5.5.4 Appendix D 1.4 |
| B-SOP-QAG-005 | Formatting and Writing of Standard Operating Procedures | Section 5.5.4.1 |
| B-SOP-QAG-006 | Archiving and Control of Analytical Data and Laboratory Documents | Section 5.4.12 |
| B-SOP-QAG-007 | QC Protocol for Preparation Batch Processing | Appendix D1 |
| B-SOP-QAG-009 | Measurement Traceability and the Selection and Purchasing of Services and Materials | Section 5.5.6, 5.5.9, 5.4.6 |
| B-SOP-QAG-010 | Non-Conformances: Data Qualifiers, Non-Conformance Reports, Corrective Action Reports, Case Narratives and Root Cause Investigations | Section 5.4.9, 5.4.10 |
| B-SOP-QAG-011 | Preparation of Data Deliverable Packages | 5.5.10 |
| B-SOP-QAG-012 | Manual Integration | Section 5.5.2.7 |
| B-SOP-QAG-013 | Mint Miner | Section 5.4.2.6 5.5.2.7 |
| B-SOP-QAG-014 | Protocol for Resolving Anomalous Situations | Section 5.4.9, 5.5.8 |
| B-SOP-QAG-015 | Monthly QA Reports and Annual Management Review of the Quality System | Section 5.4.14 |
| B-SOP-QAG-016 | Client Confidentiality and Information Security | Section 5.4.1 |
| B-SOP-QAG-017 | Qualifying Subcontractors | Section 5.4.5 |
| B-SOP-QAG-018 | Training of Technical Staff | Section 5.5.2.6 |
| B-SOP-QAG-019 | Application of Control Limits and Use of Control Charts | Section 5.5.9 |
| B-SOP-QAG-020 | Ethical Conduct and Conflict of Interest Training | Section 5.5.2.7 |
| B-SOP-QAG-021 | Preventive Actions Including Instrument Maintenance and Demonstrations of Analytical Control | Section 5.4.11 Appendix D1 |

# Appendix C - SOP Summary and Link to NELAC Standard

| SOP No. | Title | NELAC Link |
|---|---|---|
| B-SOP-QAG-022 | Measurement Uncertainty | Section 5.5.10 |
| B-SOP-QAG-023 | Data Review and Reporting of Analytical Results | Section 5.4.2.6 5.10.4 |
| B-SOP-QAG-024 | Documentation Entry and Error Correction | Section 5.5.9 |
| B-SOP-QAG-025 | Stop Work and Subsequent Return to Production | |
| B-SOP-QAG-026 | Accomplishing Effective Preventive Actions with Management of Change Systems | 5.4.11 |
| B-SOP-SPL-001 | Class 1 Weight Calibration, Balance Calibration and Daily Balance Calibration Checks | Section 5.5.6. |
| B-SOP-SPL-002 | Glassware Washing Procedures - Organic, Inorganic and Microbiological Sample Preparation | Appendix D 1.6 |
| B-SOP-SPL-003 | Percent Solids Determination (CLP SOW ILM05.2 Exhibit D Part F) | |
| B-SOP-SPL-004 | Monitoring of the Temperature of Refrigerated Storage Units and Calibrating Laboratory Thermometers | Section 5..5.6, 5.5.8 |
| B-SOP-SPL-005 | Sample Control and Storage | Section 5.5.8, 5.4.12 |
| B-SOP-SPL-006 | Sample Disposal | Section 5.5.8 |
| B-SOP-SPL-007 | Sample Container Preparation | Section 5.5.8 |
| B-SOP-SPL-008 | Sample Log-in Using Element | Section 5.5.8, 5.4.12 |
| B-SOP-SPL-009 | Monitoring Refrigerated Storage Units for Background Contamination | Section 5.5.8 |
| B-SOP-SPL-010 | Building Security | Section 5.4.12 |
| B-SOP-SPL-011 | Use of Radalert | Section 5.5.8 |
| B-SOP-SPL-012 | Legal and Internal Chain-of-Custody Protocols | Section 5.5.8 |
| B-SOP-SPL-013 | Handling, Storing, Safeguarding, Transporting, and Disposing of Foreign and Regulated Domestic Soils Samples and Associated Aqueous Residues | |
| B-SOP-WET-001 | Monitoring of the Laboratory Deionized Water System | Appendix D 1.4 |
| B-SOP-WET-002 | Determination of Fractional Organic Carbon (FOC) in Soils and Sediments | |
| B-SOP-WET-003 | Determination of Alkalinity by Titration (EPA 310.1 and SM 2320B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-004 | Analysis of Anions by Ion Chromatography (EPA 300.0, EPA 9056 and SM 4110B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-007 | Acidity as CaCO3 in Water by Titration (EPA Method 305.1 and SM 2310B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-009 | Determination of Ammonia-Nitrogen in Water (EPA 350.3 and SM 4500-NH3 D) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-010 | Determination of Total and Amenable Cyanide (EPA 335.1, EPA 335.2, SW-846 9010C and SM 4500-CN C/D/E/G Modified for Midi-Distillation; EPA 335.4 Modified for Manual Colorimetric Finish; and SW-846 9013 and 9014) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-011 | Determination of Fluoride in Water (EPA 340.2 and SM 4500-F-C_ | Section 5.5.6, Appendix D1 |
| B-SOP-WET-012 | Hardness in Water by Calculation (SM 2340B) | Section 5.5.6, Appendix D1 |

# Appendix C - SOP Summary and Link to NELAC Standard

| SOP No. | Title | NELAC Link |
|---|---|---|
| B-SOP-WET-013 | Determination of pH in Water, Soil and Wastes (EPA 150.1 and 9045C and SM 4500-H+) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-015 | Biological Oxygen Demand (EPA 405.1 and SM 5210B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-016 | Measurement of Total Solids (TS) and Total Volatile Solids (TVS) in Water and Wastes (EPA 160.3/160.4 and SM 2540B/E) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-017 | Measurement of Total Suspended Solids (TSS or Non-filterable Residue) and Volatile Suspended Solids (VSS) in Water and Wastewater (EPA 160.2 /160.4 and SM 2540D/E) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-018 | Measurement of Total Dissolved Solids (TDS or Filterable Residue) in Water and Wastewater (EPA 160.1 and SM 2540C) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-019 | Determination of Dissolved Oxygen in Water by Membrane Electrode (EPA 360.1 and SM 4500-O G) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-020 | Determination of Chemical Oxygen Demand (COD) in Water (EPA 410.4 and SM 5220 D) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-021 | Determination of Color By Visual Comparison (EPA 110.2 and SM 2120B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-022 | Specific Conductivity (EPA 120.1, 9050 and SM 2510B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-023 | Determination of Total and Dissolved Organic Carbon in Water and Wastewater (EPA 415.1, SW-846 9060A and SM 5310B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-024 | Turbidity in Water and Wastewater: (EPA 180.1 and SM 2130B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-025 | Determination of Settable Solids (EPA 160.5 and SM 2540F) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-026 | Determination of Nitrate-Nitrite in Water (EPA 353.2 and SM 4500-NO3 I) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-027 | Determination of Ortho-Phosphate and Total Phosphorous in Water (EPA 365.2 and SM 4500-P E) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-028 | Determination of Chlorine, Total Residual (EPA 330.5 and SM 4500-CL G) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-029 | Determination of Anionic Surfactants as MBAS (EPA 425.1 and SM 5540C) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-032 | Determination of Phenolic Materials in Water and Wastewater (EPA 420.1) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-033 | Determination of Sulfide in Water and Wastewater by Titration (EPA 376.1) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-034 | Determination of Carbon Dioxide in Water and Wastewater by Titration (SM 4500-CO2 C) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-035 | Determination of Sulfide in Water and Wastewater (EPA 376.2) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-036 | Determination of Sulfite in Water and Wastewater (EPA 377.1) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-037 | Determination of Salinity in Water, Wastewater and Soils (SM 2520B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-038 | Determination of Hexavalent Chromium in Water, Wastewater and Alkaline Extractions (EPA 7196A, and 3060A and SM 3500-Cr B) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-039 | Determination of Ferrous and Ferric Iron in Water and Wastewater (SM 3500-Fe B Modified) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-040 | Determination of Total Sulfides by Distillation and Titration (EPA 9030B/376.1) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-041 | Determining the Volumetric Accuracy of Centrifuge Tubes and Other Non-Class A Graduated Devices | Section 5.5.6, Appendix D1 |
| B-SOP-WET-044 | Mechanical Pipette and Dispenser Calibration Checks | Section 5.5.6 |
| B-SOP-WET-045 | Colorimetric Determination of Dissolved Silica (EPA 370.1 and SM 4500SiO2 D) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-047 | Paint Filter Liquids Test (EPA 9095A) | |

# Appendix C - SOP Summary and Link to NELAC Standard

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| SOP No. | Title | NELAC Link |
|---|---|---|
| B-SOP-WET-051 | Measurement of Dissolved Oxygen in Aqueous Samples by Winkler Titration (EPA 360.2) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-052 | Measurement of EDTA Hardness in Aqueous Samples by EPA Method 130.2 | Section 5.5.6, Appendix D1 |
| B-SOP-WET-053 | Determination of Chlorophyll A in Water: SM 10200H | Section 5.5.6, Appendix D1 |
| B-SOP-WET-056 | Spectrophotometer Wavelength Verification and Performance Evaluation | Section 5.5.9 |
| B-SOP-WET-057 | Measurement of Weak Acid Dissociable (WAD) Cyanide in Aqueous Samples (SM 4500-CN I) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-058 | Total Kjeldahl Nitrogen in Water and Soil by Block Digestion (EPA 351.2, 351.4 and SM 4500-Norg D) | Section 5.5.6, Appendix D1 |
| B-SOP-WET-059 | Measurement of Total Organic Carbon (TOC) in Solid Samples | Section 5.5.6, Appendix D1 |

# Appendix D
# SAMPLE CONTAINER AND PRESERVATIVE GUIDE
## Waste Water / Surface Water/Groundwater

| | METHOD | CONTAINER | VOLUME | PRESERVATIVE | HOLDING TIME |
|---|---|---|---|---|---|
| **Volatile Organic Chemistry** | | | | | |
| VPH - Gasoline[1] | 8015B/Gx/VPH/GRO | glass w/septum | 2 x 40 ml vials | Cool 4°C, HCL pH<2 | 14 days |
| Gasoline/BTEXMN/MTBE | 8015B/Gx/GRO/ 8021B | glass w/septum | 2 x 40 ml vials | Cool 4°C, HCL pH<2 | 14 days |
| Halocarbons | 601 / 8021B | glass w/septum | 2 x 40 ml vials | Cool 4°C [4], HCL pH<2 | 14 days[2] |
| Aromatics | 602 / 8021B | glass w/septum | 2 x 40 ml vials | Cool 4°C [4], HCL pH<2 | 14 days[2] |
| Purgeables | 624 [9] / 8260 B [9] | glass w/septum | 2 x 40 ml vials | Cool 4°C [4], HCL pH<2 | 14 days[2] |
| Alcohols or Glycols | 8015B mod. | glass w/septum | 2 x 40 ml vials | Cool 4°C , HCL pH<2 | 14 days |
| C1-C6 gases (methane, ethane, ethane, etc.) | RSK 175 | glass w/septum | 2 x 40 ml vials | Cool 4°C , HCL pH<2 | 14 days |
| **Semivolatile Organic Chemistry** | | | | | |
| EPH – Diesel and Heavy Oil[3] | 8015B/Dx/EPH/DRO | glass-amber | 1 L | Cool 4°C | 7 days[6]/40[6] |
| Semivolatiles (BNAs) | 625 / 8270C | glass-amber | 1 L | Cool 4°C | 7 days[6]/40[6] |
| Organochlorine Pesticides &/or PCBs | 608 / 8081A /or 8082 | glass-amber | 1 L | Cool 4°C | 7 days[6]/40[6] |
| Phosphorous Pesticides | 614 / 8141 | glass-amber | 1 L | Cool 4°C | 7 days[6]/40[6] |
| Herbicides | 615 / 8151A | glass-amber | 1 L | Cool 4°C | 7 days[6]/40[6] |
| Polynuclear Aromatics | 8310/8270C | glass-amber | 1 L | Cool 4°C | 7 days[6]/40[6] |
| Total Recoverable Petroleum Hydrocarbons/HEM/O&G | 1664/418.1/413.2 | glass-amber | 1 L | Cool 4°C, HCL pH<2 | 28 days |
| **Organic Chemistry** | | | | | |
| Total Organic Carbon | 415.1 / 9060 | glass-amber w/septum | 250 ml | Cool 4°C, HCl or $H_2SO_4$ to pH<2 | 28 days |
| Total Organic Halides (TOX) | 9020B | glass-amber | 500 ml | Cool 4°C, $H_2SO_4$ pH<2 | 28 days |
| **Metal Analyses[8]** | | | | | |
| Mercury | 245.1 / 7471A | poly | 500 ml | $HNO_3$ to pH<2 | 28 days |
| Low level Mercury | 1631 | Teflon | 500 ml | $HNO_3$ to pH<2 | |
| Chromium VI | 7196A/7195 | poly | 500 ml | Cool 4°C | 24 hrs. |
| Ferrous Iron | SM 3500 Fe D | poly | 500 ml | Cool 4°C | 24 hrs./6 months |
| Other Metals (not speciated) | 200 / 6000B / 7000A | poly | 500 ml | $HNO_3$ to pH<2 | 6 months |

[1] Volatile Petroleum Hydrocarbons
[2] Holding time for 600 series methods not preserved with HCl is 7 days (3 days if acrolein is included.)
[3] Extractable Petroleum Hydrocarbons
[4] If chlorinated, add sodium thiosulfate before acidification.
[5] If chlorinated, add ascorbic acid or sodium thiosulfate before acidification.
[6] Holding Times shown are days until extraction/days after extraction to analysis.
HCL preserved NWTPH-Dx, -EPH, MT-EPH and AK102 have a 14/40 hold.
[7] If chlorinated, add sodium sulfite before acidification to pH<2 with HCl.
[8] Dissolved metals should be field-filtered through 0.45micron filter, prior to preservation.
[9] An additional unpreserved VOA must be used for 2-CVE, Acrolein, and/or Acrylonitrile (the holding time for 8260B is 7 days)

# Appendix D
# SAMPLE CONTAINER AND PRESERVATIVE GUIDE

| | METHOD | CONTAINER | VOLUME | PRESERVATIVE | HOLDING TIME |
|---|---|---|---|---|---|
| **Inorganic & Wet Chemistry** | | | | | |
| Alkalinity | SM 2320B/310.1 | poly or glass | 500 ml | Cool 4°C | 14 days |
| BOD | 405.1 | poly | 1 L | Cool 4°C | 48 hours |
| COD | 410.4 | poly or glass | 500 ml | Cool 4°C, $H_2SO_4$ to pH<2 | 28 days |
| Chloride | 300.0 | poly or glass | 500 ml | None | 28 days |
| Chlorine Residual | SM 4500G/330.5 | poly or glass | 500 ml | None, do not expose to sunlight | Immediate |
| Chlorophyll-a | SM 10200H | Amber glass | 1 L | Filter, Freeze filter | 24 hours |
| Cyanide | SM 4500/9010/335 | poly or glass | 1 L | Cool 4°C, NaOH to pH>12 | 14 days |
| Flashpoint | 1010 | poly or glass | 100 ml | Cool 4°C | NA |
| Fluoride | 300.0/340.2 | poly | 500 ml | None | 28 days |
| Hardness | SM 2340B/130.2 | poly or glass | 100 ml | $HNO_3$ to pH<2 | 6 months |
| MBAS (Surfactants) | SM 5540C/425.1 | poly or glass | 500 ml | Cool 4°C | 48 hours |
| Nitrogen, Ammonia | 350.2/350.3 | poly or glass | 500 ml | Cool 4°C, $H_2SO_4$ to pH<2 | 28 days |
| Nitrogen, Nitrate + Nitrite | 353.2 | poly or glass | 500 ml | Cool 4°C, $H_2SO_4$ to pH<2 | 28 days |
| Nitrogen, Nitrate or Nitrite | 300.0 | poly or glass | 500 ml | Cool 4°C | 48 hours |
| Nitrogen, Total Kjeldahl | 351.2/351.3/351.4 | poly or glass | 500 ml | Cool 4°C, $H_2SO_4$ to pH<2 | 28 days |
| Nitrogen , Total | SM4500N | poly or glass | 500 ml | Cool 4°C, $H_2SO_4$ to pH<2 | 28 days |
| O&G/HEM/TRPH | 1664/413/418.1 | glass-amber | 1 L | Cool 4°C, HCl to pH<2 | 28 days |
| Ortho Phosphate | 300.0 | poly or glass | 500 ml | Cool 4°C, Field-Filtered | 48 hours |
| Phenols | 9065/420.1 | glass-amber | 500 ml | Cool 4°C, $H_2SO_4$ to pH<2 | 28 days |
| Phosphorous | 365.3/6010B | poly or glass | 500 ml | Cool 4°C, $H_2SO_4$ / $HNO_3$ to pH<2 | 28 days |
| pH | 150.1/9045C | poly or glass | 500 ml | None | Immediate |
| Solids (TDS, TSS, TS, TVS) | 160.1/160.2/160.3/ 160.4 | poly or glass | 500 ml | Cool 4°C | 7 days |
| Settleable Solids (SS) | 160.5 | poly or glass | 250 ml | Cool 4°C | 48 hours |
| Specific Conductance | SM 2510B/120.1/9050 | poly or glass | 500 ml | Cool 4°C | 28 days |
| Specific Gravity | SM 2710F | poly or glass | 500 ml | None | NA |
| Sulfate | 300.0 | poly or glass | 500 ml | Cool 4°C | 28 days |
| Sulfide | 9030/376.1/376.2 | poly or glass | 500 ml | Cool 4°C, Zn Acetate+NaOH pH>9 | 7 days |
| Tannins and Lignins | SM 5550 B | poly or glass | 500 ml | Cool 4°C | 48 hours |
| TOC | 9060/415.1 | glass w/septum | 250 ml | Cool 4°C, HCl or $H_2SO_4$ to pH<2 | 28 days |
| Turbidity | 180.1 | poly or glass | 100 ml | Cool 4°C | 48 hours |

# Appendix D
# SAMPLE CONTAINER AND PRESERVATIVE GUIDE

## Microbiological Chemistry

| | | | | | |
|---|---|---|---|---|---|
| Total Coliform /E.coli (P/A) | SM 9223 | poly or glass | 120 ml | Cool 4°C | 30 hours |
| Total & Fecal Coliforms | SM 9221/9222/9223 | Sterilized poly or glass | 120 ml | Cool 4°C + Sodium Thiosulfate[1] | 8 hours |
| Heterotrophic Plate Count | SM 9215B | Sterilized poly or glass | 120 ml | Cool 4°C + Sodium Thiosulfate[1] | 8 hours |
| Fecal Streptococcus | SM 9230B | Sterilized poly or glass | 120 ml | Cool 4°C + Sodium Thiosulfate[1] | 8 hours |

[1]If chlorinated, add 0.6g Ascorbic Acid

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PgG

PACIFIC groundwater GROUP

# FINAL SAMPLING ANALYSIS AND QUALITY ASSURANCE PROJECT PLAN REMEDIAL INVESTIGATION (TASK 6) PUMP GROUNDWATER FROM THE HOLE EPHRATA LANDFILL CORRECTIVE ACTION

**AUGUST 2007**

# FINAL SAMPLING ANALYSIS AND QUALITY ASSURANCE PROJECT PLAN REMEDIAL INVESTIGATION (TASK 6) PUMP GROUNDWATER FROM THE HOLE EPHRATA LANDFILL CORRECTIVE ACTION

## PREPARED FOR:

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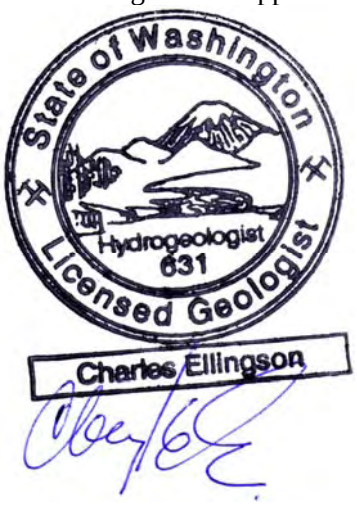
## SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.




**Charles T. Ellingson**
Principal Hydrogeologist
Washington State Hydrogeologist No. 631

# 1.0 INTRODUCTION

Pacific Groundwater Group (PGG) has prepared this Sampling, Analysis and Quality Assurance Project Plan (SAP/QAPP) for Grant County Public Works and the City of Ephrata in accordance with Chapter 173-340 (820 and 830) Washington Administrative Code (WAC) for cleanup under the Model Toxics Control Act (MTCA), Chapter 70.105D RCW.

The investigative work associated with this SAP/QAPP is scheduled to begin during the summer of 2007 and is part of the Remedial Investigation and Feasibility Study (RI/FS) for the Ephrata Landfill ("Landfill" or "Site"). The RI/FS work is being performed to evaluate Landfill cleanup requirements in accordance with WAC 173-340 as described in the RI/FS Work Plan (PGG and Parametrix, 2006).

This SAP/QAPP covers investigative work under Task 6, Pumping Groundwater from the Hole, as described in the RI/FS Work Plan. Separate SAP/QAPP plans will be prepared for Task 2 - Investigate Extent of Contamination from Drums and Tasks 3 and 4 - Explore for Other Contamination Sources and Delineate Groundwater Contamination.

# 2.0 PURPOSE AND OBJECTIVES

The purpose of this plan is to present field and analytical procedures which will be used during extraction of groundwater from well EW-1. The objective for extracting groundwater from EW-1 includes interim action and remedial investigation elements. Pumping will lower the water table and thus reduce leaching of refuse from the original landfill to groundwater. Changes in water level and chemistry over time will be used to interpret the connectivity of water in the Hole to other waters and contamination sources.

This plan presents field observation and sampling procedures, analytical methods, and data evaluation techniques to be implemented during the investigation.

The plan also identifies data quality objectives for the investigation, and presents the data generation, assessment and validation procedures so that the collected data will achieve its planned quality assurance/quality control (QA/QC) performance criteria.

This SAP/QAPP has been prepared to be consistent with requirements in the Washington Administrative Code WAC 173-340-820 and -830.

# 3.0 PROJECT ORGANIZATION AND MANAGEMENT

The following project organization and management elements describe project role and responsibilities, documentation, and reporting requirements.

## 3.1 PROJECT ORGANIZATION

The project team is formed by members of Grant County, City of Ephrata and their consultants, Washington State Department of Ecology (Ecology), Pacific Groundwater Group (PGG), and Parametrix, Inc. PGG will subcontract for laboratory services related to the investigative work.

The project Site is currently owned and operated by Grant County. Derek Pohle is the project manager for Grant County. The County will make arrangements for Site access and provide electrical power to the pump if line power is used.

The project Site was formerly owned and operated by the City of Ephrata. Wes Crago is the City Manager and project manager for the City of Ephrata's role on this project. The City has retained ENSR (formerly The RETEC Group, Inc.) to consult regarding environmental cleanup. Halah Voges is the project manager for ENSR.

Ecology is the lead regulatory agency for the project. Cole Carter is Ecology's site manager providing regulatory oversight and approvals.

Parametrix is the County's engineering consultant, with Dwight Miller the project manager and Steve Emge the project engineer for this task. Parametrix designed the evaporation pond that will be used to dispose of water and will participate in pumping and conveyance of the water.

The primary consultants for the investigative work presented in this plan will be PGG. PGG personnel will be responsible for field activities, data collection, data management, and reporting. The key PGG staff who will be involved in the investigative work are:

- Charles Ellingson, LG, LHG; Project Manager
- Dawn Chapel, LG; Assistant Project Manger, Field Manager, Project QA/QC Manager.
- Jeff Witter; Field and Analysis Support
- Wayne Rennick; GIS Specialist
- Janet Knox, LG, regulatory consultant and senior review

## 3.2 SPECIAL TRAINING AND CERTIFICATION

All personnel conducting field activities will comply with Washington Industrial Safety and Health Act per Chapter 49.17 RCW.

All laboratory services will be performed by labs accredited by the Washington State Department of Ecology.

Work will be conducted or guided by hydrogeologists and engineers licensed in the State of Washington.

## 3.3 DOCUMENTATION AND RECORDS

The following data management tools will be used to archive data collected during pumping of groundwater from the Hole:

- All groundwater quality data will be imported into the existing groundwater database.
- Field logs and sampling forms documenting field activities and other key observations will be copied and kept on file.
- All monitored pumping rates and aquifer drawdown data will be input into an MS Excel spreadsheet. Plots of drawdown over time will be prepared and analyzed.

Pacific Groundwater Group performs daily backups and monthly archiving of networked hard drive contents at its Eastlake office. In addition, project directories will be backed-up to compact disks weekly.

## 3.4 REPORTING

Following completion of pumping groundwater from the Hole, PGG will prepare a technical report including:

- Summary of field activities completed.
- Assessment of the connectivity of groundwater in the Hole to other aquifers and potential contaminant pathways.
- Summary of field and laboratory analytical results, with comparison to relevant regulatory criteria, and a review of quality assurance/quality control measures.

To the extent available, these data will be included in the technical memorandum to be produced after completion of the initial remedial investigation tasks. It will also be included in the RI/FS report.

All data will be submitted to Ecology in both printed and digital format in accordance with WAC 173-340-840(5). Digital data submittal to Ecology will be through Ecology's Environmental Information Management (EIM) database.

# 4.0 BACKGROUND

This section provides a brief overview of the Site hydrogeology and groundwater quality and rationale for pumping groundwater from EW-1. A Site map with the location of key features is shown in **Figure 1**.

## 4.1 HYDROGEOLOGY AND GROUNDWATER QUALITY

Two basalt aquifers and an outwash aquifer are currently monitored at the Ephrata Landfill. The Roza and Interflow aquifers occur in permeable weathered zones within the upper parts of the Wanapum Basalt and the Outwash aquifer occurs in the saturated sands and gravel that overlie the basalt. The basalt surface outcrops in the northern part of the site and is buried by a progressively thicker sequence of outwash sand and gravel towards the east, west and south in the direction of the bedrock slope. The Outwash aquifer is not saturated along most of the northern portion of the Landfill; except for a known low spot in the surface of the basalt below the original landfill known as "the Hole". The groundwater flow direction in all aquifers is generally to the south.

Routine groundwater monitoring indicates that the Roza aquifer and limited areas of groundwater within the Outwash and Interflow aquifers are contaminated with inorganic and organic contaminants. Potential sources of contamination include contaminant migration from the unlined original landfill, the buried drums at the northern end of the original landfill, and other unidentified sources in the northwest corner of the Site near the current shop (**Figure 1**).

The hydrogeology and current understanding of the extent of contamination at the Ephrata Landfill are discussed in detail in the RI/FS Work Plan (PGG and Parametrix, 2006).

### 4.1.1 The Hole (EW-1)

The Hole is a 20-ft depression in the basalt surface beneath the original landfill (**Figure 1**). Extraction well EW-1 was installed near the center of the Hole in the fall of 2000 (PGG, 2000). The well log for EW-1 is provided in **Appendix A** and indicates about 58 feet of refuse mixed with gravel, cobbles and sand before encountering the basalt surface at the bottom of the depression. Routine water level measurements indicate the lower 5 to 7 feet of soil/refuse within this depression is saturated with groundwater. EW-1 is screened within the saturated portion from 55.6 to 60.2 feet below ground surface (bgs). Groundwater sampling of EW-1 in 2001 (PGG, 2002) indicates the aquifer contains high concentrations of leachate indicator parameters (e.g., total dissolved solids (TDS), chloride, sulfate, iron, manganese, and sodium) as well as elevated concentrations of volatile organic compounds (VOCs).

The objective for extracting groundwater from the Hole (EW-1) is to lower the water table at the bottom of the refuse in the Hole and thus reduce leaching of refuse to groundwater. The Roza aquifer is stratigraphically below the saturated outwash/refuse in the Hole, and the two zones are separated by an aquitard. Data collected during the extraction will be used to monitor drawdown in water levels and to investigate the hydraulic connection between the Roza aquifer and the water in the Hole and possible pathways of contamination.

### 4.1.2 Contaminants of Concern

The Site contaminants of concern (COCs) are based on site history and include:

- Volatile organic compounds
- Semi-volatile organic compounds
- Inorganic compounds and metals

**Table 1** lists the Site COCs and other geochemical indicator parameters that will be analyzed during pumping of groundwater from the Hole. A constituent is listed as a COC if it continues to exceed either State Groundwater Contaminant Levels (GWCL) from WAC 173-200 or MTCA-B groundwater clean up levels from WAC 173-340 during routine quarterly monitoring (see the Work Plan for details on COC development).

# 5.0 PROCEDURES FOR PUMPING GROUNDWATER FROM THE HOLE

EW-1 will be equipped with a dedicated Grundfos Redi-Flo3 pump and discharge tubing. The pump will be powered with either a diesel generator or from a power line extended from the main shop area. The pump will be set at the bottom of the well within the screened zone and will be instrumented with a flow sleeve to keep pump motor cool at low flow rates. The pump will have an automatic shut off should water levels drop below the pump intake. The pump will be programmed to turn back on after a specified period to allow recovery (e.g.120 minutes). The recovery time will be assessed during the first extraction period. The pump discharge line will be equipped with an inline Proteus flow meter switch (or equivalent) capable of measuring flow rates from about 0.5 to 5 gallons per minute (gpm) and equipped with a totalizer for keeping track of cumulative volumes. The flow meter will be equipped with a relay switch to shut down the pump should the flow rate exceed 1 gpm. An attempt will be made to extract water at a constant, sustainable rate.

The pump discharge line will be flange-connected to 2-inch HDPE discharge tubing. The 2-inch HDPE discharge tubing will run approximately 1500 feet along the ground surface to the lined evaporation pond which will be constructed and sited along the south west corner of the original landfill (**Figure 1**). The evaporation pond is designed by Parametrix to accommodate a discharge of 1 gpm.

During most of the extraction operation period discharge to the pond will be via the discharge pipe. However, the discharge line may need to be broken or moved during landfill capping operations. During these times a storage tank will be used to store, transport, and discharge the extracted groundwater to the pond by County personnel.

## 5.1 PUMPING SCHEDULE

The groundwater pumping schedule takes advantage of the high evaporation rates in the summer time for disposal purposes. Groundwater will be pumped continuously for approximately 3 months each year during spring (mid-March to mid-June) with summer months (July-August) reserved for pond evaporation. Modification may be made to this schedule after one season of operation if warranted. The pumping schedule will repeat each year until water treatment and disposal are no longer feasible. At the end of each pumping schedule the discharge lines will be drained to prevent the lines from freezing during the winter months.

A constant pumping rate of 1 gpm will be used during extraction (about 1440 gallons per day). This rate is based on a pilot pumping test of EW-1 in 2001 (PGG, 2002) which indicates the maximum flow rate sustainable by EW-1 would be about 1 to 2 gpm. The low pumping rate also allows for easy disposal to the evaporation pond.

The extraction system and evaporation pond is currently scheduled to be built and ready for operation by mid to late October 2007. Preliminary pumping to check system performance is tentatively scheduled for late October or early November. The first 3-month spring pumping schedule will initiate in 2008.

## 5.2 MONITORING DISCHARGE AND WATER LEVELS

An inline flow meter capable of measuring flow rates from about 0.5 to 5 gpm and equipped with a totalizer for keeping track of cumulative vol-

umes will be used to monitor discharge rates and total volumetric discharge (gallons) from EW-1. Flow meter readings (rates and total volume) will be recorded in daily field logs by County personnel during the 3-month extraction period. PGG will train County personnel in meter readings and record keeping procedures.

EW-1 and two Roza aquifer wells (EW-2, MW-3b, or MW-9b) will be equipped with dedicated transducers and data loggers for continuous measurements of water levels during the extraction period. Well logs for these wells are provided in **Appendix A**. If new shallow monitoring wells are constructed in any of the exploratory borings during the source area investigation (see PGG, 2007), then at least one of these new wells will also be instrumented with a transducer. Data loggers will be programmed by PGG staff to collect water levels approximately every 1 hour. Data loggers will be downloaded by PGG personnel during each groundwater sampling event (see below) and at the end of the extraction period. Hand measured water levels will also be collected from other nearby monitoring wells during each sampling event. Based on previous testing (PGG, 2002), pumping water from the Hole is not expected to influence Roza aquifer water levels.

# 6.0 GROUNDWATER SAMPLING

The following sections describe the groundwater sampling schedule, procedures and parameters to be analyzed for groundwater extracted from the hole.

## 6.1 GROUNDWATER SAMPLING SCHEDULE

A minimum of 10 sampling events over the three month extraction period will occur. Samples will be collected frequently (approximately every 5 days) at the start of the period and decrease to every 20 days by the end of the period (**Table 2**). The sampling schedule may change if water quality parameters show large fluctuations in concentrations between sampling events.

The sampling schedule will begin when the system begins full operation in the spring of 2008.

## 6.2 GROUNDWATER SAMPLING PROCEDURE

All samples will be collected from a port at or near the EW-1 wellhead. For each groundwater sample collected, PGG will:

1. Calibrate all field instruments in accordance with manufacturer's guidelines.
2. Measure and record the following parameters on sampling form (copy of sampling form provided in **Appendix B**).
   - Depth to Water
   - pH
   - Electrical Conductivity
   - Temperature
   - Dissolved Oxygen
   - Redox Potential
   - Sulfide
   - Totalizer reading with date and time

   Redox, DO, pH, and EC will be measured with a flow through cell using a multi probe meter such as YSI®556 Multi-Probe System. Sulfide will be measured with field colorimetric test kits. Depth to water will be measured with the County's electronic sounder.
3. Collect samples of water for analysis of COCs and geochemical indicator parameters in **Table 1.** For the first sampling event, PGG will also collect samples for water treatment parameters

(**Table 1**). For all subsequent sampling events, PGG will collect samples for COCs and geochemical indicators only.

Collect samples in a manner that minimizes contact of the samples with air. Collect samples in the following order: volatile organic compounds, other organics, and then inorganic constituents. Hands and clothing shall be clean when sampling. Clean, disposable, latex gloves shall be worn when filling bottles for trace organic analyses. Follow individual sample container requirements for sample collection, handling, preservation, and shipment. Sample containers for volatile organic analyses should contain no bubbles (head space) after filling.

4. Samples for dissolved metals analysis will be filtered in the field using a 0.45 micron in-line filter. The filtration shall be recorded on the sampling form, the metals bottle, and the chain of custody form.
5. Record sample identification data on container, on the sampling form, and on the sample chain of custody record. The sample label shall include at least the following information:
    - Project name and number
    - Name of collector
    - Date and time of collection
    - Place of collection
    - The sample designation which shall be the well number (EW-1)
    - Presence of any preservative or filtration
    - Place samples in a cooler at approximately 4 degrees C with sufficient chemical ice to retain a cold temperature for 24 hours.
6. Samples will be shipped to the laboratory in a sealed cooler accompanied by Chain-of-Custody forms and any other pertinent shipping/sampling documentation. One Chain-of-Custody form will be used per laboratory shipment.

## 6.3 PARAMETERS AND ANALYTICAL METHODS

The analytical parameters to be tested for by the lab for each sampling event will include COCs and geochemical indicator parameters (**Table 1**). Water treatment parameters will be sampled only once (from both EW-1 and EW-2). Water treatment parameters will be collected during the first sampling event associated with the first extraction period. For all subsequent extraction periods, all sampling events will be for COCs and geochemical indicator parameters.

Laboratory methods acceptable for analysis of samples are to be among those described in EPA publication number SW-846, Test Methods for Evaluating Solid Waste Physical Chemical Methods; EPA-600/4-91-010, Test Methods for Determination of Metals in Environmental Samples; or EPA-600/4-79-010, Test Methods for Chemical Analysis of Water and Wastes.

All laboratory analyses will be completed by Analytical Resource, Inc (ARI) in Tukwila, Washington or their subcontractor. ARI is an accredited laboratory in accordance with WAC 173-50. Target practical quantification limits (PQLs), or reporting limits (RLs), for relatively simple groundwater matrices will be sufficiently low to allow site data to be compared to the MTCA groundwater cleanup levels (WAC 173-340) for COCs as listed in **Table 1**. However, PQLs will vary between samples and analytical methods, therefore no guarantee can be made that all PQLs will be below all cleanup levels.

# 7.0 HEALTH AND SAFETY

The Health and Safety Plan (HSP) developed for the Ephrata Landfill Remedial Investigation

Task 3 and Task 4 covers any potential hazards that may be encountered during the groundwater sampling field work associated with this plan (PGG, 2007). A copy of the RI HSP is provided as an attachment for reference.

# 8.0 QUALITY ASSURANCE AND QUALITY CONTROL

The following sections describe the quality assurance/quality control (QA/QC) measures to be preformed during the investigative work.

## 8.1 FIELD QUALITY CONTROL

Field QA/QC samples will consist of a field duplicate, field matrix spike/matrix spike duplicates, and trip blanks. The QA/QC field sampling methods are described below.

- One duplicate will be collected during the first sampling event following the procedures for groundwater sampling described above. Field duplicates for the remaining nine events will not be collected.
- A field matrix spike and matrix spike duplicate will be collected during each sampling event. Three sets of samples will be collected from a given location, one labeled with the identification for the original analysis, one labeled with the identification and suffix "-MS" and the final labeled with the identification and suffix "-MSD". The laboratory will analyze the three samples and will perform matrix spike and matrix spike duplicate analyses on the two extra sets of samples.
- A laboratory trip blank will be provided for each sampling event by the laboratory in order to assess cross contamination during transport. The laboratory will prepare 40-ml VOC containers with laboratory supplied soil or water for transport with the clean bottles from the lab to the field and back to the lab. The analytical laboratory will analyze the trip blank for the presence of volatile organic compounds.

Target acceptance criteria will be in accordance with the Contract Laboratory Program National Functional Guidelines or analytical lab guidelines.

## 8.2 LABORATORY QUALITY CONTROL

ARI will perform the water analyses. ARI is accredited in accordance with WAC 173-50 and will follow their standard QA protocol during analysis of water samples. **Appendix C** contains ARI Quality Assurance Manual which contains the following information:

- Summary of lab requirements for field sample containers, preservatives, and holding times.
- Quality control and calibration procedures; and
- Data management

## 8.3 QUALITY ASSURANCE OBJECTIVES

Quality assurance objectives for analytical data are usually expressed in terms of bias and precision. The investigation data will be evaluated using the parameters discussed below.

**Bias**. A matrix spike is prepared by adding a known amount of a pure compound to the environmental sample. A blank spike is prepared by adding a known amount of a pure compound to a laboratory-prepared blank sample. The spikes check for analytical interferences. The calculated percent recovery of the spike is taken as a measure of the bias of the total analytical method. When there is no change in volume due to the spike, percent recovery is calculated as follows:

$$PR = \frac{(O - X) \times 100}{T}$$

Where:

PR = percent recovery

O = measured value of analyte concentration after addition of spike

X = measured value of analyte concentration in the sample before the spike is added

T = value of the spike

Tolerance limits for the acceptable percent recovery of matrix spikes and blank spikes are established by the lab in accordance with CLP Guidelines.

**Precision**. Laboratory replicates are used to indicate precision. Laboratory replicates are aliquots made in the laboratory of the same sample and each aliquot is treated the same throughout the analytical method. The percent difference between the values of the replicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$RPD = \frac{2 \times (D_1 - D_2) \times 100}{(D_1 + D_2)}$$

Where:

RPD = relative percent difference

$D_1$ = first aliquot value

$D_2$ = second aliquot (replicate) value

If the precision values for the laboratory replicate are outside the laboratory tolerance limit, the laboratory should recheck the calculations and/or identify the problem. Reanalysis may be required. If the precision values for either the laboratory replicate or field duplicate are outside the tolerance limit, sample results associated with the out-of-control precision results may be qualified at the time of validation.

## 8.4 LABORATORY DATA REVIEW

Analytical data will be evaluated by PGG's project QA/QC manager with respect to the requirements of the project as specified herein. The manager will evaluate the data following Level III data-validation guidelines. These guidelines require the lab to report method blank, matrix spike and lab replicate results, but not raw data or instrument-calibration information. These guidelines are found in the CLP Guidelines.

## 8.5 FIELD INSTRUMENT QUALITY CONTROL

All field instruments will be operated and calibrated in accordance with manufacturer guidelines and documented on field and sampling forms.

# 9.0 REFERENCES


Pacific Groundwater Group. 2007. *Final Sampling Analysis and Quality Assurance Project Plan Remedial Investigation (Task 3 and Task 4) Investigation of Source and Extent of Groundwater Contamination Ephrata Landfill Corrective Action.* Consultant's report prepared for Grant County Public Works and City of Ephrata

Pacific Groundwater Group and Parametrix. 2006. *Final Remedial Investigation/Feasibility Study (RI/FS) Work Plan Ephrata Landfill Corrective Action.* Consultant's report prepared for Grant County Public Works and City of Ephrata.

Pacific Groundwater Group, 2000, *Corrective Action Well Installation Report Ephrata Landfill.* Consultant's report prepared for Grant County.

Pacific Groundwater Group, 2002, *Results of Extraction Well Pumping Tests Grant County Ephrata Landfill Ephrata, Washington.* Consultant's repot prepared for Parametrix, Inc.

**Table 1. Contaminants of Concern and Other Analytical Parameters (Groundwater Extracted from Hole)**

| Contaminants of Concern | | | |
|---|---|---|---|
| **Organic Parameters** | **Analysis Method** | **MTCA-B Levels (ug/L)** | **Lab Reporting Limits (ug/L)** |
| 1,2-Dichloroethane (EDC) | 8260B | 0.48 | 0.2 |
| 1,1-Dichloroethane | 8260B | 800 | 0.2 |
| Chloroethane | 8260B | 15 | 0.2 |
| Tetrachloroethene (PCE) | 8260B | 0.081 | 0.2 |
| Trichloroethene (TCE) | 8260B | 0.11 | 0.2 |
| 1,1-Dichloroethene | 8260B | 0.073 | 0.02 |
| cis-1,2-Dichloroethene | 8260B | 80 | 0.2 |
| trans-1,2-Dichloroethene | 8260B | 160 | 0.2 |
| Vinyl Chloride | 8260B | 0.029 | 0.02 |
| Chloromethane | 8260B | 3.4 | 0.2 |
| Dichloromethane (Methylene Chloride) | 8260B | 5.8 | 0.2 |
| Trichlorofluoromethane | 8260B | 2400 | 0.2 |
| 1,2-Dichloropropane | 8260B | 0.64 | 0.2 |
| Benzene | 8260B | 0.8 | 0.2 |
| Toluene | 8260B | 640 | 0.2 |
| Ethylbenzene | 8260B | 800 | 0.2 |
| Xylene (m, p, o) | 8260B | 1600 | 0.2 |
| 1,2-Dichlorobenzene | 8260B | 720 | 0.2 |
| 1,4-Dichlorobenzene | 8260B | 1.8 | 0.2 |
| Bis(2-ethylhexyl) Phthalate | 8270B | 6.3 | 1 |
| **Inorganic Parameters** | **Analysis Method** | **MTCA-B Levels (ug/L)** | **Lab Reporting Limits (ug/L)** |
| Chloride | 325.2 | NA | 1000 |
| Sulfate | 375.2 | NA | 2000 |
| Total Dissolved Solids (TDS) | 160.1 | NA | 10000 |
| Nitrate | 353.2 | NA | 10 |
| **Metals** | **Analysis Method** | **MTCA-B Levels (ug/L)** | **Lab Reporting Limits (ug/L)** |
| Arsenic, Dissolved | 200.8 | 0.058 | 0.04 |
| Iron, Dissolved | 6010B | NA | 50 |
| Manganese, Dissolved | 6010B | 2200.00 | 50 |

| Geochemcial Indicators | Analysis Method |
|---|---|
| Alkalinity (CaCO3) | 2320B |
| Total Dissolved Solids | 160.1 |
| Chloride | 325.2 |
| Magnesium | 6010B |
| Sulfate | 375.2 |
| Calcium | 6010B |
| Potasium | 6010B |
| Sodium | 6010B |
| Total Organic Carbon | 415.1 |

| Water Treatment Parameters (One sampling event only) | Analysis Method |
|---|---|
| Biological Oxygen Demand (BOD5) | 405.1 |
| Metals, as both total and dissolved metals | 200.8/6010B |
| Pesticides/Herbicides[1] | 8081A |
| Aldehydes[2] | 8315A |
| Total phosphorus and ortho-phosphorus | 365.2 |
| 1 specifically including aldrin, chlordane, DDE, DDT, Dieldrin, Lindane, Heptachlor, and hydrazine | |
| 2 including acetaldehyde and formaldehyde | |

| Field Parameters |
|---|
| Odor (qualitative) |
| Dissolved Oxygen |
| Redox Potential |
| Sulfide (including $H_2S$) |
| Temperature |
| Electrical Conductivity |
| pH |
| Static Water Level |

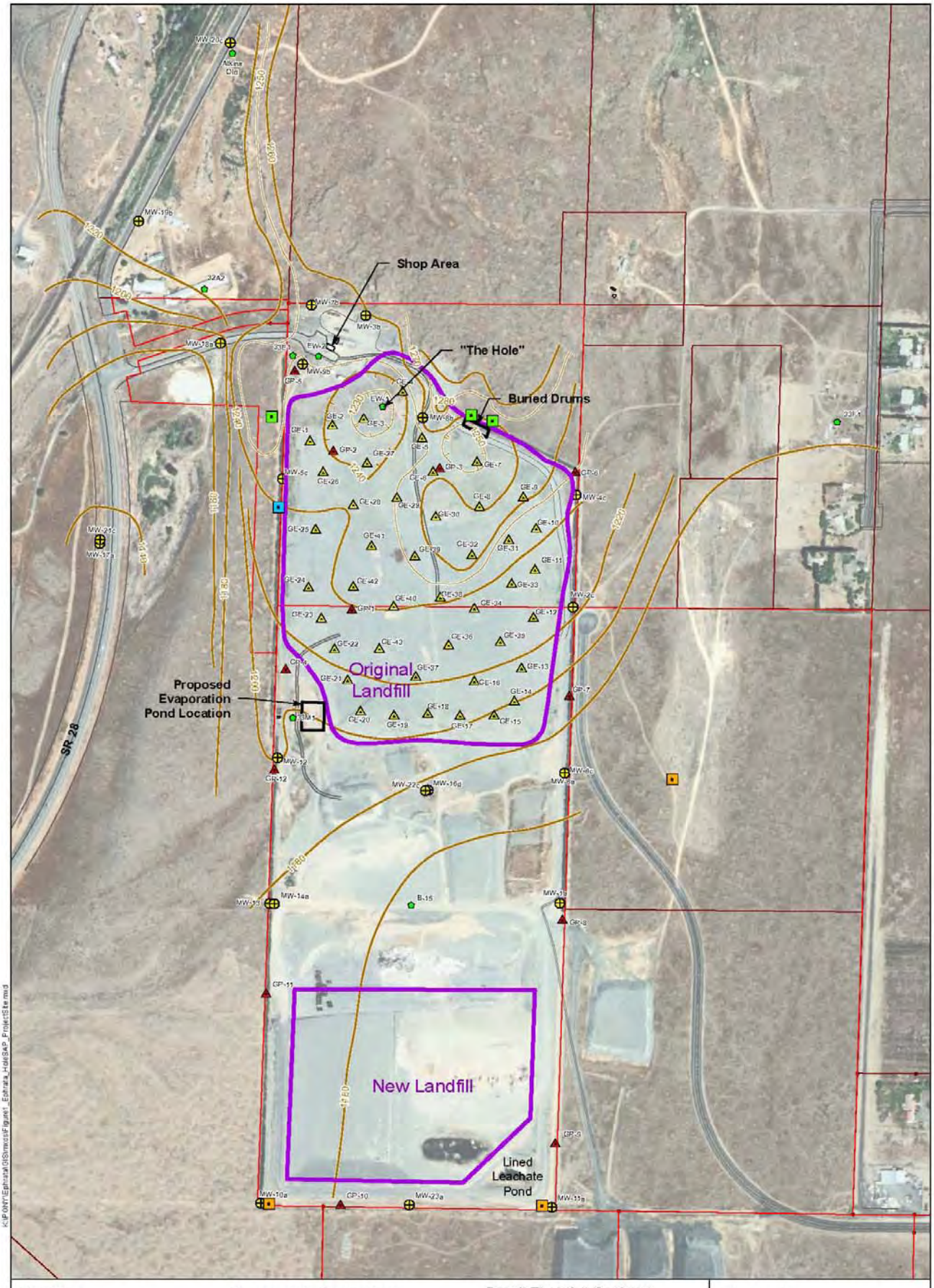



Figure 1
Project Site

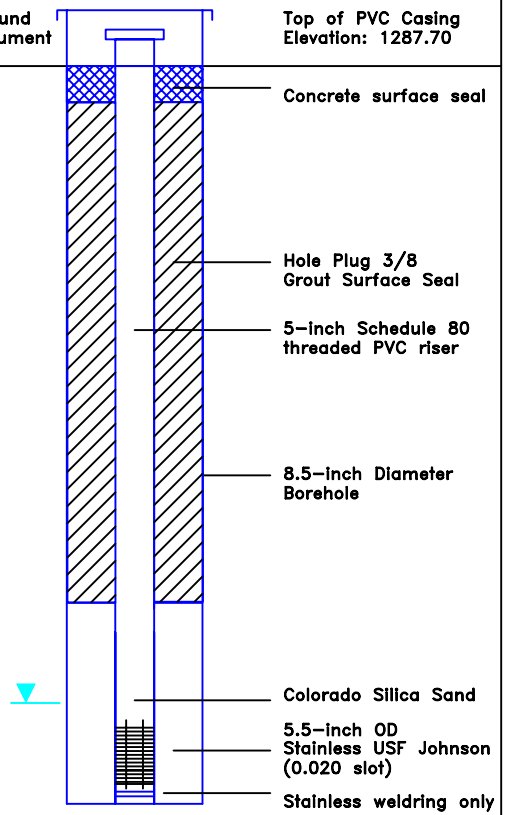
Hole SAP
Ephrata Landfill

PGG

# APPENDIX A
# WELL LOGS

# GRANT COUNTY – EPHRATA LANDFILL
## WELL EW–1

| DEPTH (feet) | GEOLOGIC LOG | % LEL | SAMPLE |
|---|---|---|---|
| | Ground Surface Elevation: 1286 | | |
| 0 | Refuse with gravel/cobble/sand slow drilling | 0 | |
| | Very smelly discharge down wind | | |
| | Increased cuttings | | |
| 10 | Drilling rate increases, more dry rock and dust, more dry refuse | 0 | |
| 20 | Shredded tires in returns | 0 | |
| | Fast drilling through dry refuse with gravel cover | | |
| | Little return | 0 | |
| 30 | Shredded, damp, black coarse–sand sized fragments 60% gravel plus glass, wood, wire, ceramic | | |
| | Hard, fast drilling, driller says not rock | | |
| 40 | No circulation | 0 | |
| | Refuse with gravel | | |
| 50 | Gravelly silt with refuse | | |
| | no refuse | | |
| 60 | Basalt | | |
| | Bottom of Boring at 60.3 feet. | | |
| 70 | | | |
| 80 | | | |
| 90 | | | |
| 100 | | | |




PROJECT NAME: Grant County Ephrata Landfill
WELL INDENTIFICATION NUMBER: EW–1
DRILLING METHOD: Air Rotary
DRILLER: Dan Claassen
FIRM: Environmental West Exploration, Inc.
CONSULTING FIRM: Pacific Groundwater Group, Inc.
REPRESENTATIVE: Charles Ellingson

LOCATION: 13106.72 N, 19225.94 E

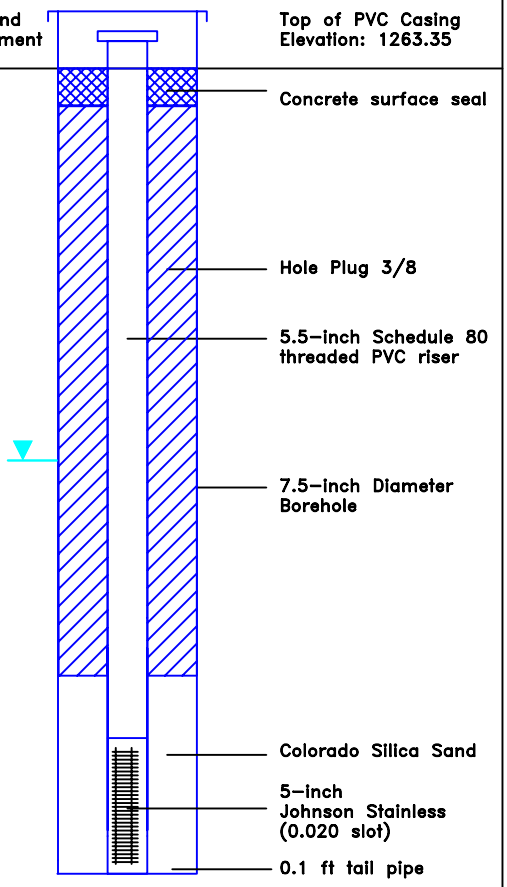
DATUM: NGVD
WATER LEVEL ELEVATION: 1232.1
INSTALLED: 9/25/00
DEVELOPED:
DOE unique well ID:

Pacific Groundwater Group

# GRANT COUNTY – EPHRATA LANDFILL
## WELL EW–2

| DEPTH (feet) | GEOLOGIC LOG | % LEL | SAMPLE |
|---|---|---|---|
| 0 | Ground Surface Elevation: 1260.85 | | |
| | Silty sand and gravel | | |
| | Basalt<br>Hard, slow drilling | 0 | |
| 10 | Weathered vesicular basalt | | |
| 20 | Hard, dry, fresh, massive basalt<br>no weathered faces, no phenocrysts | | |
| 30 | | | |
| 40 | | | |
| 50 | Drill rate increases<br>Hole making water at 55 feet | | |
| | Roza Interflow<br>Moderately soft, brown, weathered vesicular basalt – numerous weathered faces | | |
| 60 | | | |
| | Bottom of Boring at 65.9 feet. | | |
| 70 | | | |
| 80 | | | |
| 90 | | | |
| 100 | | | |

**WELL CONSTRUCTION DETAILS**



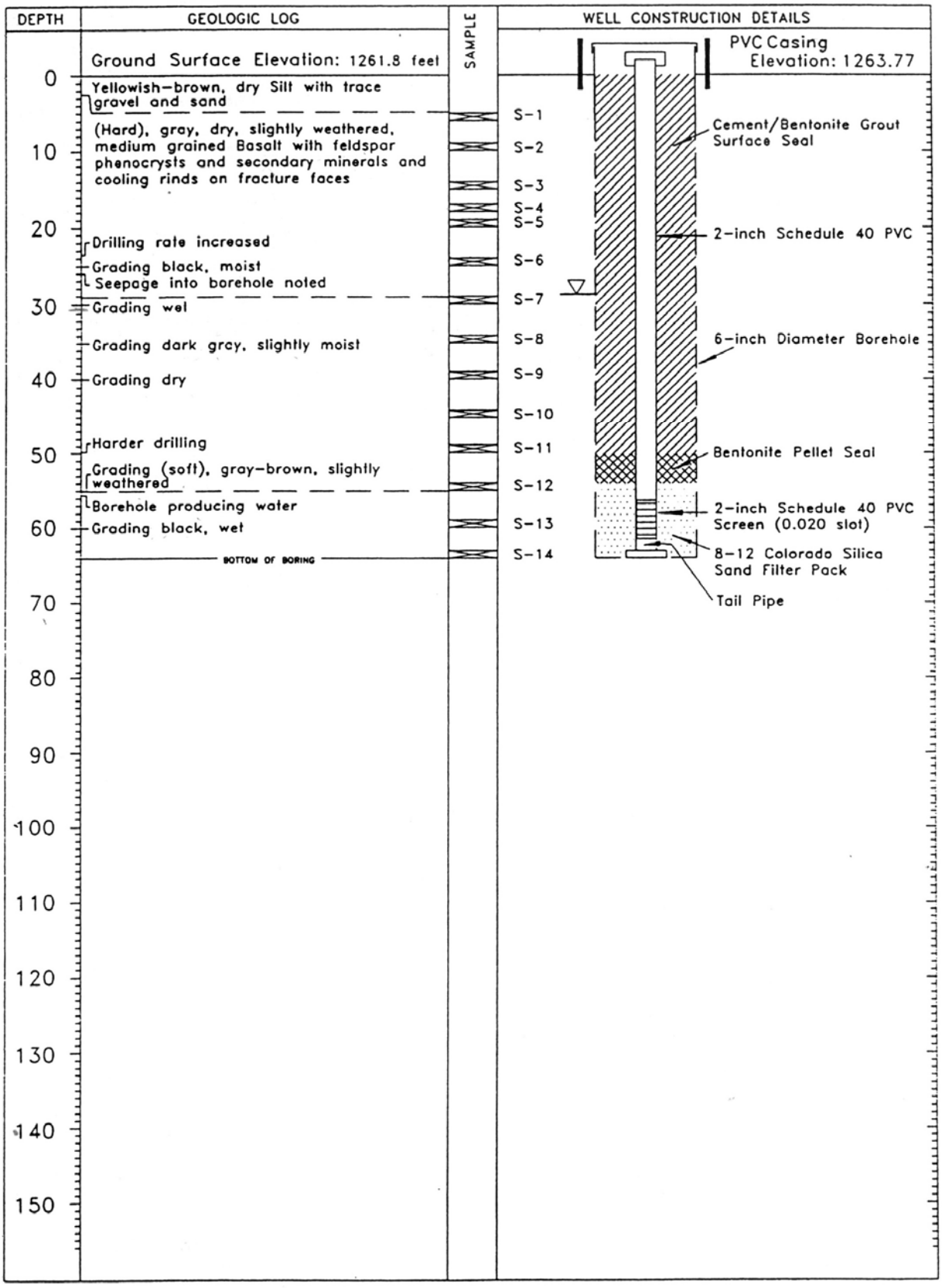

PROJECT NAME: Grant County Ephrata Landfill
WELL INDENTIFICATION NUMBER: EW–2
DRILLING METHOD: Air Rotary
DRILLER: Dan Claassen
FIRM: Environmental West Exploration, Inc.
CONSULTING FIRM: Pacific Groundwater Group, Inc.
REPRESENTATIVE: Charles Ellingson

LOCATION: 13323.49 N, 18931.03 E

DATUM: NGVD
WATER LEVEL ELEVATION: 1231.66
INSTALLED: 9/26/00
DEVELOPED:
DOE unique well ID:

Pacific Groundwater Group

# MW-3 GEOLOGIC LOG AND WELL CONSTRUCTION DETAILS



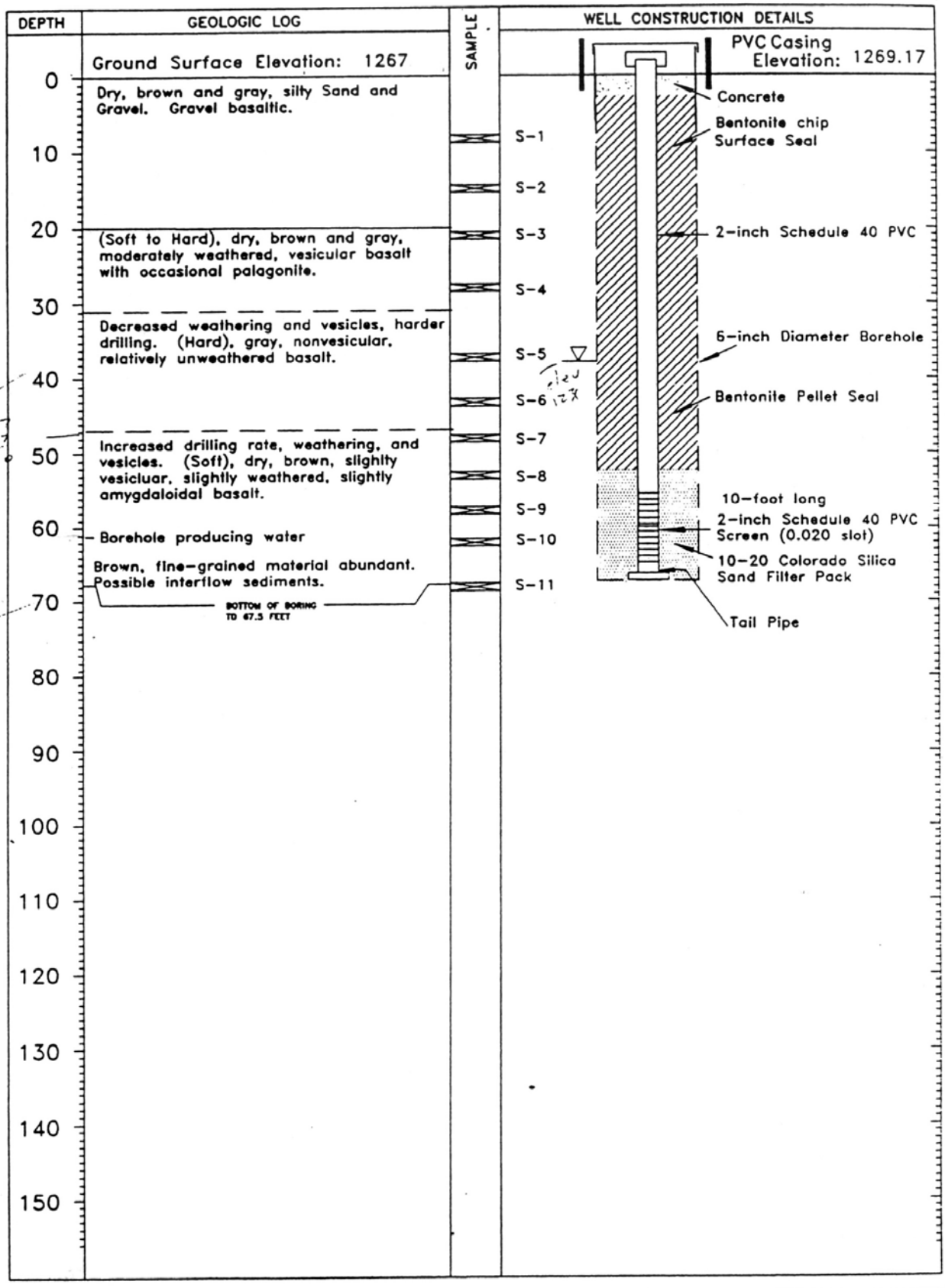

Blowback Sample of Cuttings
Push Sample (Thin Walled Tube)
* No Recovery

PACIFIC GROUNDWATER GROUP
JE8902

PROJECT NAME: Grant County Ephrata Landfill
WELL INDENTIFICATION NUMBER: MW-3
DRILLING METHOD: Air Rotary
DRILLER: Chuck Kelvirtis
FIRM: Soil Sampling Service
CONSULTING FIRM: BVWST and PGG
REPRESENTATIVE: Rajeev Dwivedi

LOCATION: SW ¼ NW ¼, SEC. 33, T21N, R26E
DATUM: NGVD
WATER LEVEL ELEVATION: 1231.60 (Nov. 1989)
INSTALLED: 6/8/89
DEVELOPED: 7/6/89
START CARD NO.:

# MW-9 GEOLOGIC LOG AND WELL CONSTRUCTION DETAILS




Blowback Sample of Cuttings
Push Sample (Thin Walled Tube)
* No Recovery

Pacific Groundwater Group

PROJECT NAME: Grant County Ephrata Landfill
WELL INDENTIFICATION NUMBER: MW-9
DRILLING METHOD: Air Rotary
DRILLER: Harold Niswander
FIRM: Soil Sampling Service
CONSULTING FIRM: BVWST and PGG
REPRESENTATIVE: Charles Ellingson

LOCATION: SW ¼ NW ¼, SEC. 33, T21N, R26E
DATUM: NGVD
WATER LEVEL ELEVATION:
INSTALLED: Oct 18, 1990
DEVELOPED:
START CARD NO.: 075075

# APPENDIX B
# SAMPLING FORMS

# GROUNDWATER SAMPLING FIELD DATA SHEET

Well #: _____

Sample #: _____

Project Number: _____ Date: _____
Project Name: _____ Location: _____
Project Address: _____ Sampled By: _____
Client Name: _____ Purged By: _____

Casing Diameter: 2"_____ 4"_____ 6"_____ Other _____

Depth to Water (feet): _____ Purge Volume Measurement Method: _____
Depth of Well (feet): _____ Date Purged: _____
Reference Point (surveyors notch, etc.): _____ Purge Time (from/to): _____
Day/Time Sampled: _____ Water Level Probe Used: _____

Purge Volume Calculation: $(\pi r^2 h)(7.48\ gal/ft^3)$(3 casing volumes)
Purge Volume (gallons) for 2" = (0.49)(h); 4" = (1.96) (h); 6" = (4.41) (h)
Calculated Purge Volume (gallons): _____ Actual Purge Volume (gallons): _____

| TIME (2400 hr) | CUMULATIVE VOLUME (gal) | pH (units) | EC (umhos/cm 25 c) | COLOR (visual) | TURBIDITY (visual) | ODOR | OTHER |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Purging Equipment: _____ Sampling Equipment: _____

Laboratory: _____ Date Sent to Lab: _____
Chain-of-Custody (yes/no): _____ Field CC Sample Number: _____
Shipment Method: _____ Split with (names/organizations): _____

Well Integrity: _____

| Quantity: | Container: | Preservatives: | Filtered (type): | Remarks: |
|---|---|---|---|---|
| | | | | |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |

Signature: _____

Page _____ of _____

Pacific Groundwater Group

# APPENDIX C
# ARI QUALITY ASSURANCE MANUAL

# Analytical Resources Inc. Quality Assurance Plan

# Quality Assurance Plan

## Analytical Resources, Inc.
## 4611 S. 134th Place, Suite 100
## Tukwila, WA 98168-3240

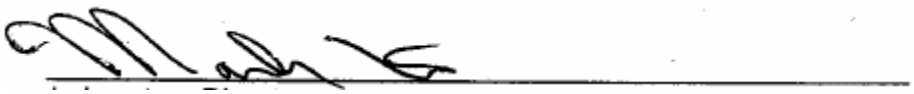
## Revision 12-007
## 4/11/06

**Uncontrolled Copy**

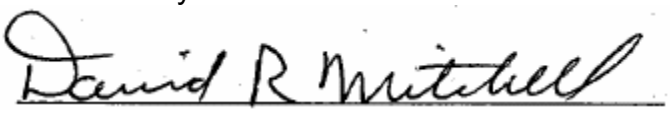
A web page is configured to inform you if this is the most recent version of ARI's LQAP. Click on the link or type the URL into your web browser. No web access? Phone 206-695-6200

http://arilabs.com/cgi-bin/rcheck.cgi?f=LQAP&r=R12007

This Quality Assurance Plan is approved and authorized for release by:



Mark Weidner
Laboratory Director



David Mitchell
Quality Assurance Manager

# Quality Assurance Plan

# Analytical Resources Inc.

**Table of Contents:**

# SECTION 1: INTRODUCTION

## Quality Assurance Policy and Objectives

Analytical Resources, Inc. (ARI) is dedicated to providing accurate and reliable data in a timely and cost effective manner. The management of ARI is committed to analytical excellence and will provide the facilities and a professional environment to achieve this goal. The quality assurance program detailed in this document sets forth the policies and procedures that are followed by ARI to ensure that all reported results are both legally defensible and of the highest quality.

To ensure that data quality goals are achieved, the following characteristics must be considered:

### Precision, Bias and Accuracy

For all analyses, there is a degree of uncertainty or error in the measurement process. This measurement error is generally one of two types: random error (precision) or systematic error (bias). Precision is a measure of agreement between replicate measurements. Bias is considered to be the difference between the expected value and the true value for a measurement or series of measurements. Accuracy is a determination of how closely a measurement is to the expected value. Both precision and bias are considered when determining the accuracy of measurements. Precision, bias and accuracy are evaluated through the use of method guidelines, and project and laboratory control limits.

### Representativeness

Representativeness is an indicator of how closely one sample aliquot resembles another aliquot from the same bulk source or sample site. Sample representativeness is more easily obtained for particulate-free water samples than for solid samples or viscous liquids. Representativeness is an important consideration in achieving other data quality objectives.

### Completeness

Completeness is an indicator of the number of valid (useable) data points compared with the overall number of data points obtained. Valid data are normally obtained when sample collection and analysis is performed in accordance with specified methods and procedures. Completeness is often expressed as a percentage: the higher the number of valid data points, the higher the overall completeness percentage. Conversely, fewer valid data points will result in an overall lower percentage of completeness. Project specifications will dictate the required level of completeness.

**Comparability**

Comparability is an indicator of how confidently one data set can be compared with another, as well as the consistency between data sets. Stable analytical conditions and adherence to standard procedures, combined with high levels of accuracy; help ensure that results obtained over a period of time will be comparable.

**Timeliness**

To ensure that the most accurate results possible are obtained, samples must be processed within specified time periods. Analytical holding times have been established to allow sufficient time for sample processing without compromising sample integrity. It is important that, while meeting timeliness requirements, other data quality objectives are still considered and met.

**Documentation**

Complete and accurate documentation is essential for verifying the integrity of analytical results. Achievement of other quality objectives cannot be used to substantiate data quality without full documentation of the analytical process. Documentation must be concise and readily available for subsequent review.

The quality assurance program at ARI has been developed to ensure that the specified data quality objectives are met for all reported results and the highest degree of completeness possible is achieved.

### 1.2 Ethics Policy on Data Quality and Confidentiality

To ensure that data quality or confidentiality is not compromised, ARI has established the following policy on corporate ethics. Following are steps that must be taken when the quality or confidentiality of data is suspected or known to be compromised. This policy applies to all ARI employees at every organizational level.

**General**

ARI's corporate commitment to integrity and honesty in the workplace is clearly stated in the ARI Employee's Handbook, under "Standards of Conduct". The Standards of Conduct statement is attached as Appendix O. The ARI commitment to excellence in data quality extends to and includes all aspects of data production, review and reporting.

Any attempt by management or any employee to compromise this commitment presents a case for serious disciplinary action. Any indications or allegations of waste, fraud or abuse will be rigorously investigated by ARI management, with the penalties for verified cases to be employment termination, and if appropriate, prosecution. In addition to these steps, any such

charges related to data generated for the federal government will also be reported to the Inspector General of the appropriate department.

## Circumstances

All ARI employees will immediately report to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any associated components).

Misrepresentation of data includes (but is not limited to) the following:

*Altering an instrument, computer or clock to falsify time or output*
*Altering the content of a logbook or data sheet in order to misrepresent data*
*Falsifying analyst identity*
*Changing documents with correction fluid with the intent of falsifying information*
*Preparing or submitting counterfeit data packages or reports*
*Unauthorized release (either written or verbal) of confidential data*
*Illegal calibration techniques (peak shaving, fraudulent integrator parameters)*
*Any attempt to misrepresent data or events as they actually occur in the course of data production or reporting*

## Responsibilities

It is the responsibility of all ARI employees to report any situation which may be adverse to data quality or confidentiality, or which may impact the final data quality. All ARI employees have the obligation to discuss known or suspected violations of this policy with laboratory management, who in turn are obliged to inform the ARI Laboratory Manager. If a satisfactory resolution is not obtained or is not possible at laboratory level, all ARI employees have the right and responsibility to discuss the matter directly with the ARI Laboratory Manager.

It is the responsibility of the ARI Laboratory Manager to promptly investigate any reports of known or suspected violations. The ARI Laboratory Manager has the authority and responsibility to resolve all known or potential violations of the policy.

It is the responsibility of ARI management to provide all of its employees with the facilities, equipment, and training to achieve the quality goals stated in the policy. It is the responsibility of ARI to provide our clients with data of known and documented quality.

## Documentation

To reaffirm an awareness of and commitment to the highest standards of data quality, excellence, and integrity, all employees are required to sign the following "Commitment to Excellence in Data Quality" statement:

"As an ARI employee, I have the right and responsibility to report any situation which may be adverse to quality or which may impact the final quality or integrity of data produced for our clients."

"I will report immediately to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any of its associated components). Examples of this include (but are not limited to): alteration of an instrument computer or clock, alteration of the contents of logbooks and/or data sheets in order to misrepresent data, misrepresentation of analyst identity, intentional falsification of documents with correction fluid ("white-out"), preparation and submittal of counterfeit data packages, use of illegal calibration techniques (peak shaving, use of fraudulent integrator parameters, etc.), or any attempt to misrepresent data or events as they actually occur in the course of an analysis."

"I will likewise alert management of any situation or activity which may be adverse to the confidentiality of clients' data."

"I will not knowingly participate in any such activity, nor fail to report such activities of which I may become aware. I understand that any voluntary participation on my part in such activities may result in the termination of my employment, and possible legal prosecution."

"Where circumstances permit, I will report any actual or suspected violations of this policy to my lab or section supervisor. If a satisfactory resolution is not obtained or is not possible at that level, I have the right and obligation to discuss the matter directly with the ARI Laboratory Manager."

## Confidentiality

All information related to client projects, such as client work plans, documentation and analytical data will be considered confidential. This information will be released only to the client or an authorized representative. Should an outside agency request information related to a client project, the client will be contacted for approval prior to releasing any information.

Some programs or contractual agreements (such as the USEPA Contract Laboratory Program) may have specific requirements for protecting a client's confidentiality Project Managers will be responsible for strict control of access to any such confidential information or documentation. All data generated from the analysis of confidential samples will also be considered confidential.

# SECTION 2.0: QA MANAGEMENT AND RESPONSIBILITIES

The principal tenet of the Quality Assurance Program at Analytical Resources Inc. (ARI) is that every employee knows she/he is a vital component of the program, and holds a responsibility to produce high-quality, defensible data in a timely manner. While production of quality data is a global philosophy, held by the entire laboratory, each section is responsible for ensuring that the data produced within that section meets the required quality objectives.

## 2.1 Overall Structure

The Board of Directors shall direct ARI's QA Policy and shall determine the Philosophy of the QA Program. It shall be the responsibility of the Laboratory Director to translate this policy into practical procedures with respect to the business plan developed for ARI, and direct the Laboratory Manager and Section Managers regarding the incorporation of these procedures into daily laboratory activities.

The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. The Laboratory Manager will coordinate Client Services, Laboratory Section Management, Computer Services, and Data Services to ensure that project requirements and data quality objectives are met.

The Laboratory Section Managers and Supervisors shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QA Manager and Project Managers. Section Managers and Section Supervisors shall instruct employees in the proper employment of QA policies.

Each Section Supervisor will ensure that analyses are completed within required holding times, that data is submitted within required submission times, and all analyses are performed according to the current Standard Operating Procedures (SOPs). They will ensure that any client modifications or QA issues are well documented for each sample set and that all required documents are complete when submitted with each data set.

The analytical staff shall execute all methods following QA policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by

Section Managers and the Laboratory Director, and once approved will be submitted to the Quality Assurance Program Manager (QAPM).

The QAPM will be responsible for controlling Company SOPs and other internal documents, overseeing the scheduling and completion of detection limit studies. The QAPM will coordinate the production of control charts and distribution of control limit data to all laboratory sections. The QAPM will administer the blind QA proficiency tests and performance samples as described in the QA Program. The QAPM will verify that QA policies and procedures are followed through out ARI.

Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.

Computer Services is responsible for ensuring that the Laboratory Information Management System (LIMS) correctly reflects the preparations and analyses performed and that the LIMS is updated with the current SOP, MDL, RL and QL data as submitted from the QAPM. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that this data matches the hardcopy deliverables submitted.

Client Services (Project Management, Sample Receiving), shall be responsible for ensuring that the laboratories understand and can meet project specific analytical requirements and DQO.

## 2.2 Hierarchical Responsibilities

**Technical Director**

> *It shall be the responsibility of the Laboratory Director to translate QA policy into practical procedures with respect to ARI's business plan, and to direct the Laboratory Manager and Section Managers in the implementation of these procedures in daily laboratory activities.*

The Director shall interpret overall QA Policy, and determine the broad practicality of policies based on methodologies, technological advances, and the current environmental market. It

shall be the interpretation of these policies that will, in turn, direct the growth ARI, the addition or withdrawal of methods to ARI′s repertoire, and ARI′s marketing focus.

At a minimum of once a year the Technical Director shall include on the agenda of the Board of Directors meeting a discussion of ARI′s QA Policy. This discussion will include the reputation of ARI for producing quality analyses, the affect of QA policies on turn-around time, competitive edge and cost-of-analysis, needs for stricter or more flexible policies, and the response of employees to the QA policies in place at that time.

At a minimum of once every six the Director shall attend management meetings, which include on the agenda the subject 'QA Program'. This format will allow for the dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. Management shall also use these meetings to discuss requirements of clients that are not met by ARI′s present QA Program, and the appropriate response to these requirements.

The Technical Director may be required to act as a technical advisor at any impromptu meetings called by management to address QA issues that cannot be immediately resolved within a laboratory section.

It shall also be the Director's authority and responsibility to hold final review approval for all SOPs of ARI. Once an SOP has been updated and reviewed by the laboratory section, it shall go through the Section and Laboratory Managers for approval, and then to the Laboratory Director for final approval before the SOP is released.

**Laboratory Manager**

> *The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. It shall be the Laboratory Manager's responsibility to coordinate Client Services, Laboratory Management, Computer Services, and Data Services to ensure that QA Program requirements and data quality objectives are met.*

The Laboratory Manager is required to attend all management meetings, at which the QA Program will be an agenda item. Management shall use these meetings to discuss requirements of clients that are not met by ARI′s present QA Program, the appropriate response to these requirements, and dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors.

It is the responsibility of the Laboratory Manager, along with the QA Manager, Laboratory Director, Section Managers and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and those accreditations that ARI will pursue. It is the responsibility of the Laboratory Manager, with the Section Managers, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Laboratory Manager has the responsibility of balancing client requests and requirements with the QA policies of ARI. It is the Laboratory Manager's task to evaluate a client's Data Quality Objectives (submitted through Client Services), and with the Section Managers to determine the feasibility of laboratory performance. Feasibility will be based on the quality objectives requested, current QA Manual, present workload (in-house and scheduled/pending), the technology in place, and staffing levels available. Current workload in-house will be evaluated using reports from Computer Services, and scheduled/pending workload will be evaluated using written and verbal input from Client Services.

The Laboratory Manager has the authority to direct Client Services to discontinue the bidding/contracting process for a new project, refuse samples, or to re-schedule projects based on Data Quality Objectives or current workload. The Laboratory Manager also shall evaluate staffing and equipment needs based on information from the Section Managers and Client Services and may elect to meet new project requirements by increasing staffing levels or purchasing additional equipment.

The Laboratory Manager serves as a senior-level technical reference for all laboratory activities, and as such will be brought in to advise on out-of-control events and trends, corrective actions, and/or other QA issues that require his/her expertise.

## Laboratory Section Managers

*The Section Managers shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QAPM and Project Managers. Section Managers are responsible for correcting out of control events within their respective laboratories. Section Managers and supervisors shall instruct employees in the proper employment of QA Policies.*

Laboratory Sections Managers shall have the final authority in decisions concerning QA policy. It is their expertise that will determine the final acceptable format of each method SOP, as they are the best resource to integrate methods into ARI's philosophy.

Laboratory Section Managers are responsible for completing or delegating updates of laboratory procedures and quality assurance manual sections as scheduled by the QA Manager.

The Section Managers are best able to determine capacity of the Laboratory Sections. To ensure that analyses are completed within required hold times, the Section Managers will give Supervisors the authority to balance employee workloads and modify employee work schedules. It is the Section Manager's responsibility to take reports from supervisors and work with the Laboratory Manager to increase staffing levels or reject samples as needed. It is the Section Manager's responsibility to work with the Laboratory Manager and the section supervisor and analysts to ensure that sample capacity does not affect the quality of data generated from that laboratory section.

It is the responsibility of the Laboratory Section Managers, along with the QA Manager, Laboratory Director, Laboratory Manager and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and which accreditation processes ARI will pursue. It is the responsibility of the Section Managers, with the Section Supervisors, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Section Manager will be responsible for reviewing training records of analysts produced by the Section Supervisor. Training shall be the responsibility of the Section Supervisor, but it is the responsibility of the Section Manager to oversee this training.

It is the Section Managers' responsibility to work with the Section Supervisor and Project Manager to assure that Project Requirements are achievable and valid for the given methods. At times, ARI's clients have requests or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently performed by the laboratory, or 3) unachievable by the instrumentation used in the laboratory. It is the responsibility of the Section Supervisor,

Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

Clients may also request modifications to the methods that must be approved by the Section Supervisor, the Section Manager and the QAPM. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services, as needed for implementation.

The Section Manager is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts or Section Supervisor.

The Section Manager has the authority to re-classify analysts or require additional training of analysts based on their performance.

**Section Supervisors**

> *It is the responsibility of each section Supervisor to ensure that analyses are completed following the most current version of ARI´s SOP, within required holding and turn around times, and assure that analyses meet the Data Quality Objectives of each project. They will ensure that any client modifications or QA issues are well documented for each sample set, and that all documentation is complete when submitted with each data set.*

To ensure that analyses are completed within required hold times, the Supervisors have the authority to balance employee workloads and modify employee work schedules. The Section Supervisors, with the input of the Section Manager, have the authority to request overtime from employees should the workload warrant the additional effort, or to modify employee schedules to extend the operating hours of the laboratory section.

The Section Supervisors shall oversee the day-to-day section operations, using LIMS printouts and verbal or written workload estimates and requests from Project Managers to adjust section efforts as needed. It is also the Section Supervisors' responsibility to inform management (Section Manager, Data Review, and Project Managers), when capacities are limited, so that the appropriate adjustments can be made to reduce workloads or increase laboratory capacities. At no time should sample capacity be allowed to affect the quality of data generated from any laboratory section.

It is the Section Supervisor's responsibility to assure that employees have the proper training for their positions. This training will include training in the methods, use of the LIMS system if applicable, training in correct documentation procedures, and all information necessary for adherence to the ARI QA Program. The Supervisor shall either perform the training personally, or designate the trainer for given methods or procedures. It is the Supervisor's responsibility to test each employee for each method or procedure, and to thoroughly document each employee's advances and current capabilities. The Supervisor shall have the authority to require further training or supervision for any employee, and shall be the authority to approve each employee for working without supervision. There will be a training record for each employee. These will be kept in the laboratory section; copies will be submitted to the QA Manager for record keeping.

It is the Supervisor's responsibility to work with the Section Manager and Project Manager to ensure that Project Requirements are achievable and valid for the given methods. At times clients have requests and/or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently part of the method as performed by the laboratory, or 3) unachievable by the instruments used in the laboratory. It is the responsibility of the Supervisor, Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

It is the responsibility of the Section Supervisor to ensure that each analyst reads and understands all requirements submitted with each sample set, including those for any special analyte, calibration, or data deliverable. It is the Section Supervisor’s responsibility to clarify any issues, with the input of the Section Manager and the Project Manager for the client.

Clients also at times will request modifications to methods, which must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for implementation.

It is the Supervisor's responsibility to ensure that each employee understands the requirements of all projects they work with. This may necessitate section meetings or project-

specific cross-section teams to work with Project Managers for large, specialty projects to ensure that everyone has the same understanding of project requirements.

The Supervisor is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts, and for ensuring that the analysts complete all documentation. If the Supervisor and laboratory section analysts cannot resolve the issues in a timely manner, the Supervisor's will request the assistance of laboratory management to bring the section into compliance. The Supervisor will also inform Project Management and his/her Section Manager of possible delays, and inform Data Review of possible time constraints they may face in preparation of data submissions from the lab section.

The Section Supervisors shall have the authority, usually in consultation with Laboratory or Project Management to use professional judgment in requiring samples be re-prepared, and shall determine which analysts have the authority to require re-preparation of samples.

It is the responsibility of the Section Supervisor to inform the QAPM, Section Manager and the Computer Services section of any changes in methodologies that will require revision of SOPs, MDLs, Control Limits or the LIMS programming. This includes changes in spiking compounds, spiking levels, preparation methods and analytical methods.

## Analysts

> *The analytical staff shall execute all methods following QA Policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by Section Managers, the Laboratory Manager, and the Laboratory Director, and once approved will be submitted to the QA Manager.*

The analysts are responsible for following the current SOPs (with project-specific modifications if required) in preparing and analyzing client samples and quality control samples to meet the project specific Data Quality Objectives. It is the analyst's responsibility to ensure that he/she understands all requirements of a project before proceeding with sample preparation or analysis.

Analysts are responsible for working with the Supervisor to ensure that all sample preparations and analyses are performed within required holding times and required turn-around times, and that all documentation is completed in a timely fashion. It is each analyst's responsibility to bring any recurrent or anticipated problems to the attention of laboratory management.

It is each analyst's responsibility to correct his/her own errors, to document corrective actions thoroughly, to perform peer review, and to ensure that fellow employees within the section follow documentation procedures.

The Section Supervisor may give lead analysts responsibility for training and evaluation of new staff members. This training will include instruction in the methods, use of the LIMS system if applicable, correct documentation procedures, and all information necessary for adherence to the ARI QA Program. Analysts will be responsible for maintaining all instruments and equipment in optimum operating condition and documenting this maintenance as required by the QA Program.

It is the responsibility of each analyst to request the assistance of Supervisors or Managers in resolving out-of-control situations that cannot be corrected in a timely manner, and to perform the documentation of all corrective action activities.

**Quality Assurance Program Manager (QAPM)**

> *The QAPM will be responsible for controlling Company SOPs and other internal documents. The QAPM will oversee the scheduling and completion of detection limit studies and control charts. The QAPM will administer the training program, analyst's proficiency documentation and performance evaluation analyses as described in the QA Program. The QAPM will verify that QA policies and procedures are followed at all levels in the Company. The QAPM will produce a "Quality Assurance report to Management" each calendar year.*

The QAPM is responsible for the oversight of the QA Program as defined by the Board of Directors and interpreted by the Laboratory Director and Laboratory Managers.

Part of this oversight will be monitoring of the QA Program through submission of performance evaluation samples, blind QA samples and double-blind QA samples. It is the responsibility of the QAPM, along with the Laboratory Manager, Laboratory Director, Section Managers and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate. The QAPM will be responsible for submitting these samples to the laboratory for analysis, overseeing submission of the results to the appropriate agencies, and for control of documented proficiency results.

The QAPM will be responsible for scheduling laboratory section SOP and procedural reviews and revisions, and section updates of the Quality Assurance Manual. It is the responsibility of

the QAPM to work with each Section Manager to attempt to stagger these review schedules across the year within each laboratory section. The QAPM will also be responsible for maintaining document control of all SOPs, bench sheets, logbooks, and other forms used within the laboratory.

All laboratory sections, on an annual basis, will perform detection limit studies for each method used within each section. It is the responsibility of the QAPM to schedule, review, compile, and distribute the results of these studies.

The QAPM is responsible for evaluation of the laboratories' adherence to defined protocols through periodic audits of completed projects and of the laboratory facilities. Following the audit schedule (Appendix K), the QA Manager will perform the scheduled audit and prepare an evaluation that will be submitted to the Board of Directors in the Annual QA Report to Management.

The QAPM will be responsible for evaluation of outside accreditation requested by Client Services. The QA Manager will deliberate with the Laboratory Managers and Laboratory Director on the feasibility of pursuing accreditation based on the scope of the accreditation, the effort required to pursue accreditation and the scope of work that might become available once the accreditation is obtained. If a decision is made to pursue an accreditation, it is the responsibility of the QAPM to coordinate laboratory efforts towards the accreditation.

The QAPM will produce an annual "Quality Assurance Report to Management" to be distributed to ARI management personnel as described in Section 13 of this LQAP.

The QAPM will serve as a resource for quality-related issues for all Laboratory Sections, and will serve management in an advisory capacity.

The QAPM will have documented training in elementary statistics and Quality Systems theory.

**Data Reviewers**

*Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.*

Data reviewers shall ensure that all samples are analyzed according to approved methods by reviewing the data released by each laboratory section. The data will be evaluated for compliance with all Data Quality Objectives as defined in the method SOP or in the project-specific quality assurance plan, including instrument tuning and calibration, holding time, spiking level, and spiking recovery criteria. Data reviewers will also verify 100% of manual calculations, spot check computer calculations, check electronic data for correct sample matching, and do a 100% check on any manually entered data. Analytical parameters, which have concentration interdependence, will be evaluated in relationship to each other.

Final reports generated will be evaluated to ensure that laboratories are using the current detection limit/reporting limit values and the current control limits. Data will be checked to ensure that all QA issues are addressed and fully documented. Reviewers are responsible for working with Laboratory Supervisors, Laboratory Managers and Project Managers when out-of-control events are incompletely documented, or if data is found to not meet Data Quality Objectives of a project without documentation.

It is the responsibility of data reviewers to work with Computer Services to ensure that the LIMS is updated to the current limits and methods used within the laboratory.

**Computer Services**

> *Computer Services is responsible for ensuring that the LIMS correctly reflects the preparations and analyses performed and that the LIMS is updated to include the current SOP, MDL, RL and QL data, as submitted by the QA Manager. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that electronic data matches the hardcopy deliverables submitted.*

It is the responsibility of the Computer Services Manager to update, or to designate the task of updating, the LIMS as determined by Laboratory Management, including adjustment to current MDL/RL data, additions of analytes to methods, changes in method designations or changes in calculations for methodologies.

Computer Services will be responsible for generating the work list scripts required to allow analysts to enter data into the LIMS, and for generating the report scripts that produce final hardcopy or electronic reports for clients.

Computer Services Management and personnel are also responsible for generation and review of electronic data deliverables (EDD), as requested by clients through Project Management. Computer Services personnel will review the EDD for compliance with the Software Quality Assurance SOP before it is released to the client.

Computer Services will be responsible for informing laboratory Section Managers and Project Managers of any discrepancies found between the EDD and the hardcopy, and for following up on corrections to hardcopy and EDD as required.

## Client Services

> *Client Services (CS) (Project Managers, Sample Receiving, and Sales Management) personnel are the primary interface between ARI's clients and the laboratory sections. CS staff shall be responsible, with the assistance of the Section Managers and Supervisors, for ensuring that the laboratories understand and can meet the Data Quality Goals and Requirements of each Project before committing laboratory services to the project. CS will monitor the quality of sample processing after they are received.*

Client Services Management and Project Managers shall ensure that the laboratories can meet the data quality objectives for a project. The Project Managers are responsible for knowing the capabilities of the laboratory, in order to develop project proposals or accept samples without consultation with laboratory management. It is the responsibility of Client Services to consult with the Laboratory Manager and Section Managers, or supervisors designated by Management, when data quality goals are not included in standard Company policies. Clients may, at times, request modifications to methods that must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for verification of feasibility. Laboratory Management may determine that a project should not be pursued based on the specific Data Quality Objectives and on current or projected laboratory capacity.

Project Managers shall be responsible for ensuring that project requirements and analytical requests are submitted correctly to all laboratory sections. Once samples have been logged into the laboratory, it is the responsibility of the Project Managers to ensure that all information is available to the laboratories concerning the Data Quality Objectives and deliverables

requirements. It is also the responsibility of the Project Managers to convey changes in client requirements to the laboratories and ensure that all paperwork reflects the changes if necessary.

It is the responsibility of Project Managers and Client Services Management to assure that specific EDD formats are submitted to Computer Services and approved as feasible before contracting with a client to provide the EDD.

It is the responsibility of Project Managers to notify clients of out-of-control events, “problem” samples, or anticipated turn-around time delays, as conveyed to them by Laboratory Management. It is also the responsibility of Project Management to work with Laboratory Management in setting priorities during times of heavy sample workloads.

Project Managers shall be responsible for coordinating data submissions and compiling hardcopy data for final submission to the client. This involves conducting a fourth level data review, from which any data which is found to contain errors that were not found earlier in the review process is returned to the Data Reviewer for correction and/or corrective action. The Project Manager will be responsible for compiling all analyst notes into a project narrative. This will include discussion of any sample receipt discrepancies, sample preparation and analysis difficulties or non-compliance, and any corrective actions that may have been required during processing. It will also discuss quality control analyses and results if applicable to the sample set.

Project Managers shall work with Laboratory Management in determination of the direction of growth for ARI, as the Project Managers are best able to define the analytical needs of clients based on new technologies and new environmental regulations.

# SECTION 3: PERSONNEL QUALIFICATIONS AND TRAINING

The production of quality analytical data is dependent upon a laboratory staff with qualifications and training necessary to perform assigned tasks. All personnel employed by ARI will receive adequate training and instruction specific to their responsibilities. Prior to assigning a staff member full responsibility for performing a laboratory procedure, her/his skills will be evaluated and verified acceptable. It is the obligation of ARI's supervisors and managers to ensure that personnel are qualified to successfully perform all assigned duties.

ARI's training program is described in SOP 1017S (*Training and Demonstration of Proficiency*). The procedures described in this SOP assure that all ARI employees are proficient at the tasks required to produce quality analytical data. The SOP also provides for periodic review of each employees training and proficiency status, which may indicate any need for additional or remedial training. All training and review procedures are documented as described in the SOP. Appendix B of this document includes specific requirements of the training program and examples of the forms used to document training.

Basic elements of ARI's training program are:

1. All employees are required to read and document their knowledge of non-technical documents that describe general policies in place at ARI. These documents include ARI's *Employee Manual* and ARI's *Chemical Hygiene Plan*.
2. All employees are required to read and document their knowledge of ARI's *Laboratory Quality Assurance Plan* and quality assurance policies.
3. All new employees must attend a Quality Assurance Orientation during which ARI's general and specific requirements for the production of quality analytical data are emphasized. A typical orientation agenda is included in Appendix B.
4. All new employees will attend a Technical Orientation conducted by their laboratory supervisor or manager. The technical orientation is used to provide specific information about laboratory operation to the employee and to assess the new employee's education

and skill level. The section supervisor or manager is responsible for determining the level of training necessary for each staff member.

5. All employees will complete an 'on the job' training program designated by their supervisor. The training program will be laboratory, SOP and employee specific. Training programs follow the general outline provided in Appendix B. The training is incremental with each step documented in an employee Training File. While an analyst is in the training period, her/his supervisor or trainer must approve all analytical work. Upon completion of the training program the employee is considered proficient and may perform without supervision the SOPs listed in the training program.
6. The proficiency of each employee performing a given laboratory SOP will be continually monitored and documented as described SOP 1017S. An employee must continually generate data that meets all of ARI's published acceptance criteria for a given SOP to be considered proficient. Unacceptable results or insufficient number of analyses performed in a calendar quarter will result in revocation of proficiency. This will result in a remedial training program.
7. Periodically, as described in SOP 1017S, internal and/or external Performance Evaluation (PE) samples will be used to document staff competency. Technicians and analysts will participate in the preparation and analysis of blind samples for all methods they routinely perform. Results of these blind samples will be evaluated to verify staff proficiency. Staff members associated with acceptable performance evaluation samples will be considered proficient for those methods. Conversely, unacceptable performance evaluation sample results may signal the need for additional or remedial training.
8. A training file is established for each technical employee. The file will document an employee′s experience, training and proficiency. The training file will document each specific PE sample analysis performed by an analyst. Either an employee′s supervisor or Quality Assurance Program personnel will update the training file. The training file will be maintained in the employee′s laboratory as outlined in SOP 1017S.

# SECTION 4: FACILITIES AND EQUIPMENT

## 4.1 Facilities

ARI's facilities have been designed to allow for efficient sample processing and analysis while maintaining consideration for the health and safety of the staff. The facility accommodates the following operations:

*Sample receipt and storage*
*Sample container preparation and shipment*
*Sample preparation and analysis (organic and inorganic)*
*Project planning and management*
*Quality assurance*
*Data review and report generation*
*Computer programming and operations*
*Records storage*
*Instrument spare parts storage*
*Short-term hazardous waste storage*

A detailed description of ARI's facilities is included as Appendix C.

## 4.2 Security

### Facilities

To ensure that security at ARI is maintained, access to the facilities is limited to employees and escorted visitors. Upon arrival, ARI visitors are required to register at the reception desk, and must sign out prior to leaving. Visitors will be escorted at all times. A receptionist constantly monitors the main entrance. Other laboratory entrances remain closed at all times and can only be opened from the outside by key. Key access to the facility is controlled; keys are issued on a limited basis depending on access needs.

As a result of controlled access and a monitored alarm system, the entire facility is considered a secure area. This eliminates the need for locked sample storage refrigerators, data storage areas or file cabinets.

### Data Access

The Computer Services Manager controls security of, and access to, electronic data on the LIMS. Security measures are required to ensure data integrity, but must not be so restrictive

as to prevent data accessibility. The security measures taken at ARI are to prevent intentional intrusion by outside parties. These measures include building security, limited computer system access, password systems, encryption, firewalls and the use of virus protection programs. ARI's Intranet is protected from outside tampering by a proxy server (firewall) connection to the Internet.

**LIMS - System Security**

Building/Computer Room Security

Access to the building is restricted to employees, vendors with security passes, and escorted visitors. Room 203 contains the computer and main console for the LIMS system. This room is closed and locked at all times. Access to this room is limited to Computer Services personnel, escorted repair technicians, and escorted visitors. Only Computer Services personnel will be allowed access to the main console.

System Password Policy

User name and password restrict access to the LIMS computer. Remote access to the LIMS server is not allowed.

Database Access Restrictions

Interaction with the database is menu-controlled and allows the LIMS Manager to restrict access. Technicians may be given the ability to fill a limited number of work lists, with no authorization to distribute data. Some users may be given "read only" access to the database.

Users will be given access to the database only to complete tasks for those analyses for which they are responsible. No users are to be given access to the shell or command prompt unless 1) they have completed the appropriate training and 2) administrative access to the computer systems is required by their job function

### 4.3 Safety

Ensuring that all sample processing and analysis procedures are performed under safe conditions is an important consideration at ARI. While safety is the responsibility of all staff members, ARI's Safety Committee meets monthly to review the safety activities of all laboratory sections and to ensure that all operations and equipment meet safety criteria. *The*

*Chemical Hygiene Plan* details those safety procedures and requirements that must be followed at ARI. *The Chemical Hygiene Plan* is reviewed annually and updated as needed to incorporate any changes to ARI's safety program.

## 4.4 Instrumentation and Support Equipment

### 4.4.1 Instrumentation

Generation of quality data is dependent upon instrumentation and support equipment that is in optimum operating condition. All instrumentation will be optimally maintained per method requirements and manufacturer recommendations. Preventative maintenance will be performed on a routine basis, with more frequent maintenance during periods of increased sample load or after analysis of highly contaminated samples. Preventative maintenance is instrument and analysis specific, and each maintenance logbook has been designed specifically for the instrument type. Required maintenance procedures are listed in analytical SOPs. Each maintenance logbook will detail the type and frequency of maintenance for that instrument. Each maintenance logbook is kept with the instrument. Non-routine maintenance and repairs will be performed as necessary. Spare parts are kept on hand when possible; necessary parts are ordered on an expedited basis to minimize downtime. All maintenance and repair activities will be documented in the appropriate logbooks.

Currently available Laboratory Instrumentation is detailed in Appendix C.

### 4.4.2 Support Equipment

4.4.2.1 Thermometers - – All thermometers in use at ARI are traceable to an NIST standard and are calibrated or verified annually. The procedures are described in SOP 1020S.

4.4.2.2 Water Baths, Incubators and Ovens – The temperature of water baths and ovens currently used in the analytical process are monitored daily. Temperatures are recorded on temperature logs that are audited monthly by Quality Assurance personnel. Temperature controls on these devices are calibrated annually by an outside vendor. Calibration reports are filed in the QA Office.

4.4.2.3 Refrigerators and Freezers - Refrigerators and freezers are assigned an acceptable operating range of temperatures. The temperature is monitored daily. Corrective Action is required for all out of range temperatures.

4.4.2.4 Balances – The accuracy of all balances is verified prior to daily use with two Class S weights that bracket the normal weighting range of the balance. All analytical balances are professionally cleaned and calibrated annually by an outside contractor. Class S weights are calibrated every three years by an outside contractor. Calibration reports are filed in the QA Office.

4.4.2.5 pH Meters – pH meters are standardized prior to daily use with at least two standards, one at 4.0 and one at 7.0 pH units. The meters are checked prior to each use with a pH 7.0 buffer.

4.4.2.6 Variable Volume Pipettes – The accuracy of variable volume pipettes is verified monthly following the procedure in SOP 1015S.

4.4.2.7 Sample Containers – Upon client request ARI will supply sample containers for collection of field samples. All containers supplied for organic and trace metals analyses are certified pre-cleaned by the manufacturer. Containers for Conventional analyses are not pre-cleaned and are certified internally by ARI following the procedures in Appendices of ARI SOP 001S (Sample Receiving). The manufacturer's certification may be above ARI's reporting limit for some analyses. When this is the case ARI performs a Method Blank analysis using a container from a given lot and certifies that the lot is suitable for sample collection.

Container lot numbers are recorded when containers are sent to a client.

### 4.4.3 Chemical Standards and Reagents

#### 4.4.3.1 Reagent Water Supply

ARI maintains a centralized water purification system. The quality of the water produced is monitored and documented daily. Routine maintenance, out of control events and corrective actions are documented for each system in a logbook. All reagent / de-ionized water used within the laboratory meet or exceed ASTM Type II Standards. Water used in the Volatile Organic Laboratory is also filtered through activated charcoal to remove organic compounds. .

#### 4.4.3.2 Chemical Standards

All quantitative standards used for calibration in an analytical process are traceable to a National Institute of Standards & Technology standard if one exists. Non-traceable standards are verified against traceable standards or through the analyses of Standard Reference Materials. A Certificate of Analysis is filed in the QA Section or laboratory for all quantitative standards. The source, date of receipt, required storage conditions and an expiration date will be documented for all standards. All containers used to store standards will be labeled with an expiration date. Receiving, storage and preparation of calibration standards is described in SOPs 526S (Metals Analysis), 620S (Conventional Analysis), 704S (Volatile Organic Analysis) and 1012S (GC and GC-MS Analyses).

#### 4.4.3.3 Chemical Reagents

Many of the analytical processes in use at ARI require chemical reagents that are not directly used in the calibration process. These reagents are used to accomplish such tasks as analyte preservation, adjustment of pH, the forming of colorimetric indicators, etc. These reagents are purchased in a grade and purity sufficient for their intended use. The receipt of all reagents is recorded in the Chemical Receiving Logbook where a unique Inventory Number is assigned to each reagent. Each original reagent container is labeled with an Inventory Number, the date it is opened and an expiration date as appropriate. A Certificate of Analysis is obtained for reagents when available and archived in the QA Office.

Solutions prepared from reagents are recorded in the Reagent Preparation Logbook. The logbook includes a unique Reagent Number that is traceable to the Chemical Receiving Logbook. Reagent containers are labeled with Reagent Number, date of preparation, expiration date, and preparer′s identification.

Procedures for Reagent Receiving and Preparation are detailed in SOP 1013S.

#### Trace Metals Acids

To ensure the quality of acids, nitric and hydrochloric, used for trace metals analyses, only the highest quality, certified “metals free” acids are purchased. Each lot received is analyzed for purity prior to use in the laboratory to assure that it is acceptable for use. Whenever possible,

entire lots will be reserved for use exclusively by ARI. This minimizes the possibility of receiving contaminated or unacceptable acid.

**Solvents**

To ensure the quality of solvents used for sample preparation and analysis, the highest purity of solvents required for sample processing will be used. Purity checks will be performed on solvent lots received by the laboratory. Only those solvent lots determined acceptable will be used for sample processing. Whenever possible, entire solvent lots will be reserved for use. This minimizes the possibility of receiving contaminated or unacceptable solvents.

**Compressed Gases**

To reduce the possibility of system contamination, compressed gases and liquids used for operating analytical instrumentation will be of a specified purity level. Any cylinder suspected of introducing contamination into a system will be promptly replaced.

## 4.5 Computer Systems

ARI maintains several data systems. These are used to automate such diverse functions as accounting, payroll, sales and marketing, sample receiving, instrument data collection, production of hardcopy and electronic data deliverables, intra- and internet applications and project management. Specific information about these systems is contained in Appendix C and various SOPs.

ARI maintains a Laboratory Information Management System (LIMS) that stores analytical data, calculates final results and produces final reports (both hardcopy and electronic). The LIMS system is the major data system used at ARI. A separate Software Quality Assurance Plan outlines the QA/QC procedures for the LIMS system.

# SECTION 5: LABORATORY DOCUMENTATION AND RECORDS

All laboratory operations and procedures performed during sample processing are documented in logbooks, notebooks and on laboratory forms and bench sheets. Analytical data and copies of paper documents are also stored electronically. Consistent use of standard documents throughout the laboratory ensures that all activities will be traceable and serves as objective evidence of the work performed.

All procedures performed at ARI will be detailed in Standard Operating Procedures (SOPs). Sample preparation and analysis SOPs will reference approved analytical methods and detail the actual procedures followed by ARI staff. SOPs for non-analytical activities will detail the procedures developed specifically for use at ARI.

## 5.1 Responsibilities

All staff members are responsible for complete and accurate documentation of laboratory activities. Each laboratory section develops a comprehensive set of documents (bench sheets, forms, etc.) to record all activities performed in that section. All staff members are responsible for reviewing and understanding SOPs, and must sign a record to document this fact. The QAPM is responsible for maintaining control of laboratory documents and ensuring their consistent use.

To ensure that all documents, SOPs in particular, accurately reflect the activities performed at ARI, section supervisors and managers are required to review all documents annually and recommend changes to the QAP. The QAPM is responsible for coordinating document revisions and ensuring that all staff members have access to the most current laboratory documents.

## 5.2 Document Control

ARI's Quality Assurance Program requires that all forms and SOPs used within the laboratory be monitored to ensure that only the currently approved version of the documents are in use, centrally organized, and readily available to all staff members. All documents will include a

revision date. The LQAP and SOPs will also have an effective date. The time between the revision and effective dates will be used for training and orderly implementation of changes.

Electronic copies of laboratory documents will be maintained as part of the quality assurance files. Each laboratory section maintains working copies of pertinent forms and SOPs. The QAPM coordinates the generation of new forms or SOPs and modifications to existing documents. Log number assignments will be as follows:

| Laboratory Section | Form Number | SOP Number |
|---|---|---|
| Client Services | 0001 - 0999 | 001 - 099 |
| Computer Systems | 1000 - 1999 | 100 - 199 |
| Data Services | 2000 - 2999 | 200 - 299 |
| Extractions | 3000 - 3999 | 300 - 399 |
| GC Laboratory | 4000 - 4999 | 400 - 499 |
| Metals Laboratory | 5000 - 5999 | 500 - 599 |
| Conventional Laboratory | 6000 - 6999 | 600 - 699 |
| Volatile Organic Laboratory | 8000 - 8999 | 700 - 799 |
| Semi-volatile Laboratory | 7000 - 7999 | 800 - 899 |
| Quality Assurance Monitoring | 10000 - 10999 | 1000 - 1099 |
| GeoTech Laboratory | 11000 - 11999 | 1100 - 1199 |

Document numbers will be include an F for forms and an S for SOPs i.e. 101F or 1234S. Document Control Logs of all forms and SOPs, detailing the form name and number, revision number and revision date will be maintained by the QA Officer. Outdated documents will be maintained in an electronic archive file.

The QAPM will distribute new and revised documents to the appropriate laboratory sections. Section staff will replace outdated copies of the document with the revised version. Laboratory forms and SOPs will be generated or revised on an “as needed” basis, and will be reviewed and revised as at least annually. Only the latest version of a form or SOP will be available in each laboratory. Section supervisors will periodically review these documents and recommend

changes to be implemented by the QAPM. A comprehensive review of all laboratory documentation will be performed annually at the direction of the QAPM.

To maintain document security, release of documents to clients or other outside agencies will be controlled by the QAPM. The QAPM will record the document to be released, revision number, person and agency receiving the document, and the release date. All documents generated by the laboratory will be considered proprietary. ARI permission must be obtained by anyone releasing the document to other agencies or including the document in a project or quality assurance plan.

### 5.3 Reference Documentation

To provide an understanding of the procedures employed to generate quality data, a comprehensive set of reference materials is available to staff members. All activities performed within the laboratory can be referenced to a method or SOP. The laboratory maintains copies of the following method compilations:

*Code of Federal Regulations (Section 40)*
*Test Methods for Evaluating Solid Waste (USEPA SW-846)*
*USEPA Contract Laboratory Program Statement of Work for Organics Analysis*
*USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis*
*Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series methods)*
*Standard Methods for the Examination of Water and Wastewater*
*Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)*
*US Naval Facilities Engineering Support Activity –NFESC (formerly NEESA).*
*Hazardous Waste Remedial Actions Program (HAZWRAP)*
*State of Alaska Department of Environmental Conservation (ADEC)*
*Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods*
*Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)*
*Washington State SARA*
*AFCEE Project Quality Assurance Plan*
*Washington State EPH/VPH Methods*
*National Environmental Laboratory Accreditation Conference*
*Department of Defense Quality Systems Manual*
*Washington State Sediment Sampling and Analysis Plan*

Other methods followed within the laboratory are also available. Published modifications to analytical methods will be reviewed and incorporated into laboratory SOPs. If a method for a parameter is developed by ARI, it will be detailed in an SOP. SOPs will be available for all

laboratory activities. Each laboratory section will maintain a file or notebook of SOPs pertinent to that section. A compilation of all laboratory SOPs is maintained as part of the Quality Assurance Program files. A listing of laboratory SOPs is included as Appendix E.

The Quality Assurance Manual provides an overview of the laboratory-wide Quality Assurance program. A copy of the Quality Assurance Manual is distributed to all laboratory sections. Distribution of the QAP is coordinated by the QAPM.

ARI maintains a file of various laboratory and environmental publications and reference texts. These reference materials are available to all staff members. Operation and maintenance manuals are available for all equipment and instrumentation used within the laboratory. Additionally, senior level staff members are available to serve as reference sources. These staff members have numerous years of pertinent experience and can provide insight and guidance for all procedures and laboratory activities.

### 5.4 Quality Assurance Policies

Quality Assurance Policies provide standards and procedures to guide ARI employees in proper implementation of the QA Program. Appendix P includes current QA Policies.

### 5.6 Worksheets and Logbooks

Use of Laboratory Forms and Logbooks

All activities noted on laboratory forms and logs will be recorded in blue ink. Initials of the staff member performing the activity, as well as the date the activity is performed will be noted on all forms and logs. Any supplementary information about the activity, such as unusual observations or suspected procedural errors will be noted on the forms and logs. Laboratory logbooks will be prepared and controlled by the QAPM or his/her designee.

Changes to existing information will be annotated by drawing a single line through the original entry and initialing and dating the deletion. Correct information will be written above the deleted entry. When appropriate to clarify the intent of the change a note describing the reason for the change will be added. The use of correction fluids or other techniques that cover the entry in its entirety are not used on laboratory documents.

Since sample processing within an analytical laboratory involves many detailed steps, documentation can be quite extensive and varied. The following guidelines will be followed to encourage consistency in laboratory record keeping:

Standard Logbooks

Preparation of all stock and working standards is documented in the appropriate standards logbook. Each entry includes preparation date, initial and final concentrations (including solute and solvent amounts), standard ID number, expiration date and the identity of the person preparing the standard. Stock solution entries include standard lot number and supplier. Working solution entries include the stock solution ID number. Commercially prepared stock standards are recorded in the stock standard logbook.

Sample Storage Temperature Logs

The temperature of all refrigerators and freezers used for sample and standards storage is monitored daily. The temperature and recorder's initials are recorded on the temperature log attached to each unit. The acceptable temperature range for each unit is noted on the log sheet. Any out of control temperatures and/or corrective actions, must be noted on the log sheet and reported to appropriate personnel (Lab Supervisor and QA Manager)

Balance Calibration Logs

The true and measured values for each calibration check weight are recorded, along with the date and recorder's initials. Any actions taken, such as notifying the QAPM of malfunctions is indicated alongside the entry for that date.

Instrument Logs

The Instrument Run Logs must detail all samples analyzed on a given instrument for a given parameter. Instrument conditions, analysis date, analyst initials and standard or sample identifications in the analytical sequence must be recorded in the log. Comments related to sample analysis and minor maintenance are noted on the instrument logs. For GC/MS analyses, instrument performance is documented by recording internal standard response alongside the sample identification.

Sample Preparation/Analysis Worksheets

Sample preparation and analysis activities are documented on appropriate worksheets. Sample identifications, weights or volumes used, intermediate cleanups, final volumes, preparation dates and analyst initials will be noted as well as any observations about sample condition. Any issues encountered during sample preparation are also noted. Surrogate and spiking solution ID numbers, and concentrations added to the samples, must be indicated on the bench sheet.

For some parameters, analytical results are summarized on an analysis worksheet. Sample identifications, sample preparation information, sample results, quality control results, analysis date, analyst initials and reported detection limits must be indicated on the worksheet. Any necessary data qualifiers are also noted on the worksheet.

Maintenance Logs

All major maintenance performed on instrumentation or laboratory equipment must be documented. Maintenance performed, date and analyst performing the maintenance, and steps taken to verify that the maintenance was successful are detailed in the log. Routine maintenance of GC-MS instruments is documented on “maintenance cards” attached to each instrument. The demonstration that GC instruments are in-control following maintenance is documented in the instrument run log.

Individual Laboratory Notebooks

Staff members preparing USEPA CLP samples must maintain unique laboratory notebooks for these analyses. Each case submitted is documented on a separate, sequentially numbered page. A listing of all samples prepared as part of the case, the date and the preparer’s initials, and any notes specific to sample preparation must be annotated in the logbook. Individual notebooks are used only when required by a specific contract. All sample preparation information is recorded on a laboratory bench sheet.

## 5.5 Document /Data Storage and Archival

Logbooks

All active logbooks will remain in the appropriate laboratory sections. Completed logbooks will be forwarded to the QAPM for archival.

Magnetic Tapes and Diskettes

When instrument capabilities permit, all data generated is archived and stored on magnetic tapes or disks. The electronic media remains on file for approximately two years.

Chromatograms and Instrument Documentation

Electronic or paper copies of chromatograms, instrument calibrations, quantification reports and any other printed documentation generated during sample analysis are maintained as part of the permanent data files. All hardcopy data remain on file at ARI for five (5) years or longer as specified by contract.

Project Data and Documentation

Project data and support documentation, electronic or paper copies, will be filed a minimum of five (5) years, or as specified by contract.

# SECTION 6: SAMPLE CONTROL

All samples analyzed by the laboratory will be monitored in accordance with sample control procedures. Sample control includes operations such as container preparation, sample collection, receipt and storage, and tracking of the sample throughout all processing steps. Documentation of all sample control activities and adherence to standard procedures is an important aspect of ensuring that data quality objectives are met.

## 6.1 Sample Collection

Production of quality analytical data begins with proper sample collection. Improper sampling procedures may result in inaccurate final results. Although the laboratory is not routinely involved with sample collection, it will minimize the possibility for error by providing clients with appropriate sample containers and sampling instructions for the requested parameters. If, upon receipt, sample integrity appears to be compromised, the client will be immediately notified to allow for re-sampling if necessary.

## 6.2 Sample Container Preparation and Shipment

To minimize the possibility of contamination from containers furnished by outside sources, the laboratory will furnish all necessary sample containers for client projects when requested by the client. Sample containers, pre-cleaned to EPA specifications, or certified clean by the manufacturer or ARI, are supplied for most parameters. Containers for special purposes may be acquired upon request. Lot numbers for containers are tracked to link bottle orders to lot numbers.

A blank sample label is affixed to each sample container prior sending the container to a client. The sample label allows for recording of the following information at the time of collection: client name, client sample identification, sampling site, date and time of sample collection, analytical parameters, and any preservatives used. Sample labels provided by ARI are coated to prevent bleeding of recorded information if labels become wet.

To ensure that the correct number of appropriate sample containers are prepared and submitted to the client, a Bottle Request is completed by a Client Services staff member or Project Manager at the time sample containers are ordered by the client. All necessary

preservatives are also noted on the Bottle Request. The Bottle Request is then forwarded to appropriate personnel in the Sample Receiving Section for order preparation. All required containers will be gathered and preservatives added as specified. A copy of the Bottle Request accompanies the sample containers to allow the client to verify that the order is properly filled. Additional containers will be supplied for quality control purposes and in case of container breakage or sampling complications. A complete listing of containers and preservatives used within the laboratory is included as Appendix F.

To facilitate transportation of containers to the sampling site, sample containers will be placed in coolers along with appropriate packing material. The inclusion of packing materials, such as vermiculite or "bubblewrap", is provided to minimize the possibility of container breakage and cross-contamination. Sample containers will be organized in the coolers per analytical or client specifications. Depending on client preference and project requirements, coolers and sample containers will be shipped to a specified location, delivered by ARI courier, or held at the laboratory for pick up. To ensure that sample identification, analytical parameters, and sample custody are properly documented, Chain of Custody records will accompany all sample container shipments. When appropriate, as for drinking water source sampling events or for parameters that require preservation in the field, sample collection instructions will also be included with shipments.

### 6.3 Sample Admission

All samples received by the laboratory are processed in a central Sample Receiving area. To ensure the safety of staff members receiving samples, coolers will be opened under a hood or in a well-ventilated area. Appropriate protection, such as disposable gloves, safety glasses and laboratory coats will be worn during sample receipt and log-in. Additionally, all general safety practices as specified in ARI's Chemical Hygiene Plan will be employed.

Upon receipt, sample coolers will be inspected for general condition and custody seals. Time and date of sample receipt, as well as identification of the staff member receiving the samples, will be indicated on each Chain of Custody record accompanying the shipment. Cooler temperatures will be determined using an IR temperature measuring device or by placing a thermometer in the cooler immediately after the cooler is opened. If samples cannot be logged-in within 30 minutes after receipt, the sample coolers will be tagged and placed in the

walk-in sample storage refrigerator for short-term storage. Chain of Custody records for the stored coolers will remain in Log-In to ensure that processing of the stored samples is not overlooked.

Samples to be processed will be removed from the coolers and organized by sample identification. The number and type of sample containers received will be verified against the Chain of Custody record. Each sample container will be examined to verify that the condition is acceptable and that sample integrity has not been compromised during shipment. Sample containers broken during shipment should be handled according to procedures detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

After sample organization and initial inspection has been completed, sample information will be entered into the LIMS, and a Service Request will be generated for the sample set. The Service Request serves as a work order for the laboratory. The Service Request will contain the following information:

*Client Name*
*Client Project Name and/or Number*
*Client Contact*
*Verified Time of Sample Receipt (VTSR)*
*Required Turnaround Time*
*Laboratory Job Number*
*Client Sample Identifiers(s)*
*Laboratory Sample Number(s)*
*Required Parameters*
*Additional Analytical Requirements/Comments*

Also entered into the LIMS are the number of sample containers for each sample, sample conditions, and cooler temperatures.

A sequential laboratory job number will be assigned to each sample set. Laboratory sample numbers, determined by the job number and a sequential letter, will be assigned to each sample. Containers for each sample will also be numbered sequentially. The accuracy of sample container labeling is verified by a second person. These identifiers will be used to monitor the sample set and container throughout sample processing. All samples logged for the sample set and the analytical parameters required for each sample will be indicated on the Service Request. Client specific quality control requirements and any other pertinent

information indicated on the Chain of Custody Record will also be noted. Discrepancies between the Chain of Custody record and sample containers will be noted, as well as discrepancy resolutions. To reduce the possibility of inaccurate sample processing, the sample receiving staff working with the Project Manager will resolve all noted discrepancies prior to releasing the samples to the analytical sections.

Upon completion of sample log-in, all documentation will be placed in a master folder and forwarded to the assigned Project Manager for review and approval. The master folder will be color-coded as follows:

| Master File Color | Designation |
|---|---|
| Red | Accelerated Turnaround (≤ week) |
| Clear | Routine Turnaround |

The Project Manager will review all aspects of the documentation, specify any additional analytical requirements and resolve any remaining discrepancies before sample processing begins. After Project Manager final approval has been obtained (indicated by the Project Managers initials and the date on the Service Request and laboratory-specific parameter sheets), the master file will be returned to Log-In for preparation of laboratory job folders. A job folder will be created for each laboratory section involved in sample processing for a given project. Laboratory job folders are color-coded as follows:

| Job Folder Color | Designation |
|---|---|
| Red | Accelerated Turnaround (< 7 days) |
| Yellow | Accelerated Turnaround (7-14 days) |
| Orange | Organic Extractions (Routine TAT) |
| Blue | NWTPH-HCID Analyses |
| Neutral (manila) | >14 day TAT |
| Pink (or other) | Client Specific |

Copies of the Service Request and all pertinent laboratory-specific documentation required to accurately complete sample analysis will be placed in each laboratory job folder. Laboratory job folders will then be distributed to appropriate laboratory sections for analysis and incorporation into the section tracking system.

Subcontracting Policies

In some instances, ARI cannot perform certain analyses due to current laboratory workload limitations or specific analytical equipment requirements. In these instances it becomes necessary to subcontract work to other laboratories. In order to guarantee that data quality and defensibility are of the same high standards that ARI strives to achieve within our laboratory, policies regarding selection and use of subcontractor laboratories have been established as follows:

1. ARI's client must be made aware that samples will be subcontracted and what laboratory they will perform the analyses.
2. The sample information and analytical requirements are first entered into the ARI LIMS in the same way that samples for in-house analyses are processed. Subcontractor laboratories are contacted to verify their preparedness, and samples are then submitted to them using ARI chain-of-custody forms. These chain-of-custody documents are included in the master folder for the project.
3. Subcontractor laboratories must qualify to perform the analyses using the same criteria applied to ARI. When appropriate, subcontracted laboratories may be asked to submit documentation such as proof of certification or accreditation, quality assurance plans, standard operating procedures, results of method detection limit studies, control limits to ARI. ARI may at its discretion perform an on-site assessment of subcontracted laboratories. Failure to submit requested documents or refusal of an on-site assessment will disqualify laboratories from subcontracting ARI sample analyses.
4. ARI may request that subcontract laboratories analyze, on double blind performance testing (PT) sample obtained from commercial vendors at the subcontractor's expense.

5. The laboratory must be willing to maintain an annual contract with ARI, and must list ARI as a co-insured on the subcontract laboratory's liability insurance policies. Financial stability is also evaluated on a lab-by-lab basis.

### 6.4 Sample Custody

To ensure the traceability of sample possession, chain of custody is documented from sample collection to completion of final analysis, and is maintained during sample storage in archive prior to disposal. This is achieved through completion of a written chain of custody record. Custody of all samples and extracts processed by the laboratory is documented at each step of the analytical process.

The National Enforcement Investigations Center (NEIC) of EPA defines custody in the following ways:

*It is in your actual possession, or*
*It is in your view, after being in your physical possession, or*
*It was in your possession, then you locked or sealed it up to prevent tampering, or*
*It is in a secure area.*

Sample handling may vary and specific custody procedures have been developed for each laboratory section.

Custody at Sample Log-in

A Chain of Custody Record must accompany all samples received by the laboratory. This record documents all sampling activities as well as persons handling the samples prior to receipt by the laboratory. Sample receiving staff assumes custody of samples upon receipt from the client or courier. Samples will remain in the custody of Sample receiving until the samples are delivered to a laboratory section. Should samples require shipment to a subcontracting laboratory, a separate Chain of Custody Record will be completed to document the sample transfer. Chain of Custody records will be included with sample data reports in the final analytical package submitted to the client. Copies of these records will be filed with project data.

Custody of Volatile Organic Analysis (VOA) Samples

Upon completion of sample the sample receiving process, samples requiring analysis for volatile organic analysis will be placed in the VOA refrigerator (freezer) designated for incoming samples and logged into the VOA sample receipt logbook. The samples are now in the custody of the VOA laboratory. To avoid possible cross-contamination of low level samples, those samples known or suspected to contain high levels of contaminants, will be stored in a separate refrigerator prior to analysis.

VOA Laboratory analysts complete the receiving process and move the samples to a refrigerator designated for "active" samples. Samples removed from storage for analysis are considered to be in the custody of the analyst responsible for sample processing. All samples to be analyzed will be listed in the analytical logbook for the selected instrument. Laboratory and client sample identifications, the bottle number and Identification of the analyst performing the analysis will be indicated in the logbook. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from sample analysis, to further document sample custody.

After completion of sample analysis, soil and intact water sample containers will be placed in the refrigerator designated for sample archival. Any water sample remaining in the container after completion of analysis will be considered compromised and will be discarded. The samples will remain in archive and in the custody of the VOA laboratory until final disposal.

Custody of Semi-volatile Organic Analysis (SVOA) Samples

Upon completion of sample log-in, samples requiring extraction for organic parameters will be placed in walk-in cooler number 5. All samples placed in the cooler will be logged into the *Walk-in Admission Logbook*. Removal of samples from the refrigerator for processing by Extractions or Conventional personnel must be indicated in the *Walk-in Admission Logbook*. Samples stored in this walk-in refrigerator remain in Log-In custody until removed to a laboratory for processing.

The analyst responsible for the custody and initial handling of samples within the sample preparation laboratory will be indicated on the Sample Preparation Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Residual sample volumes will be archived in the refrigerator designated for extractable organic samples. Transfer of residual samples to this refrigerator will be documented in the *Sample Archive Refrigerator Logbook*. Transfer of prepared sample extracts to the appropriate analytical sections will be documented in the Extract Log in the preparation laboratory and in the Extract Log in the analytical section. Upon extract transfer, the analytical section receiving the extract assumes custody.

Extracts removed from storage for analysis are considered to be in the custody of the analyst responsible for analysis. Removal of extracts for analysis will be indicated in the Extract Log in the analytical section. All extracts to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory and client sample identifications, as well as the analyst performing the analysis will be indicated in the logbook. Analysts will initial raw data generated from extract analysis to further document sample custody. After completion of analysis, extracts will be placed in the refrigerator designated for archive. Extracts will remain in storage and in the custody of the analytical section until final disposal.

Custody of Inorganic and Metals Samples

Upon completion of the sample receiving process, samples requiring preparation or analysis for inorganic parameters will be placed in the designated walk-in cooler. Selected samples such as those requiring a critical analysis are placed directly in the laboratory. Removal of samples from the refrigerators for digestion and/or analysis will be indicated in the *Walk-in Admission Logbook* for the appropriate refrigerator. Samples stored in the walk-in refrigerators remain in Log-In custody until the laboratory removes the samples for processing.

The analyst responsible for custody and initial handling of samples within the metals preparation laboratory will be indicated on the Sample Digestion Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Transfer of completed sample digests to the metals instrument (analysis) laboratory will be

documented by the metals preparation laboratory. Upon transfer of digests, custody is considered to be the responsibility of the analytical section receiving the digests.

Digests removed from storage are considered to be in the custody of the responsible analyst. . All digests to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory sample identifications and the analyst performing the analysis will be indicated in the logbook. If it is necessary for digest custody to be transferred to another instrument or analyst, the second analyst records this information. Thus, custody of a given digest can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from digest and analysis to further document sample custody. After completion of analysis, digests will be stored by and remain in the custody of the analytical laboratory personnel until final disposal.

The analyst performing the sample analysis will remove samples requiring analysis for other inorganic (conventional) parameters from storage. Removal will be documented in the *Walk-in Admission Logbook*. Custody of the sample will be considered to be the responsibility of that analyst. All samples to be analyzed will be indicated on the worksheet for the required parameter. Laboratory sample identifications and the analyst performing the analysis will be indicated on the worksheet. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. The analysts' initials will be indicated on the worksheet to further document sample custody.

Special Chain of Custody Requirements

Should a client project require additional or more detailed custody documentation, requirements will be incorporated into the procedures for that project. Samples processed as part of the USEPA Contract Laboratory Program require more stringent chain of custody procedures. For this program, removal of samples and extracts for analysis (or any reason) will be documented in the Sample Control Log. Date, time and reason for removal, and date and time of return, will be fully documented. Removal of samples or extracts for permanent archiving or disposal will also be fully documented in the Sample Control Log.

### 6.5 Sample Archival and Disposal

After completion of analysis, unused sample aliquots are routinely stored for a specified period of time: 30 days for water samples and 60 days for soil samples. Colored markers are placed on samples with specific storage requirements during the sample receiving process. The color-coding is defined in the following table:

| Label Color | Storage Requirement |
|---|---|
| Red | Hold until further notice |
| Orange | Suspected Hazardous |
| Yellow | Shared Sample containers |
| Blue | Samples to be frozen |

Samples submitted for archival will be logged into the Sample Archive Logbook. Laboratory and client identifications, as well as archive date will be indicated in the logbook. The anticipated disposal date for the sample set will also be noted. The logbook will be reviewed several times during each week to determine samples scheduled for disposal. On or soon after the scheduled disposal date, the samples will be removed from archive storage and disposed.

In consideration of disposal requirements for hazardous samples, each sample processed by the laboratory will be evaluated for contamination levels based on final analytical results. Those samples containing analytes of interest at or above regulated disposal levels will be identified and handled as hazardous waste. A designated staff member coordinates periodic pickup and disposal of hazardous waste by an USEPA approved TSD (Treatment, Storage, and Disposal) Company and maintains hazardous waste disposal records. Specific guidelines for handling hazardous samples and waste are detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures)

# SECTION 7: PROJECT MANAGEMENT AND TRACKING

## 7.1 Project Management

Concise and accurate communication between a client and ARI, and within the laboratory, is an extremely important requirement for generating quality analytical results. All clients contracting with ARI will be assigned to a Project Manager. The Project Manager confirms that project requirements are consistent with laboratory capabilities, and coordinates with laboratory sections to provide analytical results within specified project timelines. Project organization, monitoring, and follow-up is the responsibility of Project Management staff.

Client project requirements and Project Managers' areas of expertise will be considered for client assignment. To ensure that all clients and projects receive the attention necessary for successful project completion, Project Manager workloads will also be considered. Project Managers will serve as the central focus for all project related activities and communications.

The Project Manager will review work plans and requirements for all pending projects. Any questions related to the work plan will be addressed prior to project commencement. The Project Manager will consult with appropriate analytical sections to clarify any issues regarding procedures and capabilities. Project deliverables requirements will also be addressed at this time. Upon receipt and log-in of project samples, the Project Manager will review all documentation to ensure that samples were properly logged in, and that analytical and QC requirements were correctly specified. The Project Manager will also provide any additional project related information that will assist the analytical sections with sample analysis. Laboratory sections will not process a sample until Project Manager approval has been given. Exceptions are parameters with critical (less than 48 hour) holding times or those that arrive on weekends or holidays when none of the Project Managers can be contacted.

Throughout the project, the Project Manager will monitor all analytical activities to help ensure that the project is completed and delivered on schedule. Any issues arising during sample processing will be promptly discussed with the client. Likewise, the analytical staff will be informed of any client concerns or project modifications. The Project Manager will also address any issues that arise during subsequent review of the analytical data by the client.

### 7.2 Project Tracking

Monitoring the laboratory workload ensures that adequate staffing and equipment will be available to produce quality analytical data and meet client needs. At the time a client project is tentatively scheduled, information regarding the project will be documented in the Project Management Database. Project particulars, sample quantities, parameters and anticipated sample delivery dates will be specified, as well as any prearranged analytical costs. Project work plans and any other project information will be kept on file with the Project Manager. Schedules for pending projects are communicated to the lab sections through periodic distribution of database printouts. Upon receipt of project samples, the project Inquiry number will be referenced to ensure project requirements are accurately specified. The original project documentation will be placed in the master folder as part of the project file.

Each laboratory section analyzing project samples will be responsible for ensuring that all analyses are accurately completed by the required date. All staff members are required to be aware of holding times, special analytical requirements, and required turnaround times. Analytical sections will remain in close communication with the Project Management staff so that any issues arising during sample analysis can be promptly addressed or discussed with the client.

Project Managers or their designee are responsible for monitoring project status. Sample status reports are generated as needed from LIMS and are distributed to lab sections and Project Managers. These reports allow the Project Managers to review project status and identify any samples which must be expedited to meet project timelines. Additionally, verbal communication between Project Managers and lab sections provides information about project status.

After sample analysis, report generation, and final review have been completed, data and final reports will be forwarded to the Project Manager. If requested, preliminary and interim results will be forwarded to the client. When all final data are available, the Project Manager will assemble the final package, verifying that all analyses were completed and project requirements met. A project narrative detailing the particulars of sample processing will be generated. After assembly and prior to shipment, the Project Manager will perform a final, cursory review of the package for any inconsistencies or incorrect information. The package

will then be forwarded to clerical personnel for photocopying and shipment. The Project Manager will determine final analytical costs and submit this information to the Accounting department for invoicing. Upon completion, all raw data and documentation associated with each client project will be compiled and stored as part of the laboratory project files. A chart detailing laboratory workflow as described in this section is included as Appendix G.

# SECTION 8: ANALYTICAL METHODS

To ensure that all data generated are consistent and comparable, clearly defined procedures will be followed for all aspects of sample processing, control and management. Standard Operating Procedures (SOPs) provide detailed guidelines for completing a procedure. Document control procedures and periodic audits will ensure that operations are performed in accordance with the most current SOPs. All routine deviations from published will be noted in the SOPs. Analysis specific deviation will be noted in Analyst Notes and in the Analytical Narrative.

## 8.1 Responsibilities

It is the responsibility of staff members to perform all procedures in accordance with the guidelines specified in the Standard Operating Procedures. Laboratory management is responsible for ensuring that SOPs are followed throughout the laboratory. The QAPM is responsible for coordinating periodic review and revision of existing SOPs and generation of additional SOPs. The QAPM is also responsible for maintaining SOP document control and ensuring that the most current versions of all SOPs are available to staff members.

## 8.2 Methods

Laboratory procedures may reference any established methods specified in the following publications:

*1. Code of Federal Regulations (Section 40)*
*2. Test Methods for Evaluating Solid Waste (USEPA SW-846)*
*3. USEPA Contract Laboratory Program Statement of Work for Organic Analysis*
*4. USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis*
*5. Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series)*
*6. Standard Methods for the Examination of Water and Wastewater*
*7. Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)*
*8. Navy Installation Restoration Laboratory Quality Assurance Guide(February 1996)*
*9. Hazardous Waste Remedial Actions Program (HAZWRAP)*
*10. State of Alaska Department of Environmental Conservation (ADEC)*
*11. Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods*
*12. Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)*
*13. The Department of Defense Quality Systems Manual (DoD-QSM)*
*14. Washington State Sediment Sampling and Analysis Plan*

The laboratory will adhere to established methods whenever possible. Occasionally, however, procedures determined to provide more accurate final results will be incorporated into the method. Should the laboratory procedures deviate from the established method, all modifications will be detailed in the associated SOP. A listing of laboratory SOPs is included as Appendix E.

### 8.3 Standard Operating Procedures

Standard Operating Procedures (SOPs) are detailed, step-by-step instructions for completing a laboratory operation. SOPs will address all procedures within the laboratory, from initial project identification to final data archival. SOPs will be generated for procedures developed within the laboratory and for those that follow established methods.

To ensure consistency in defining procedural guidelines, all SOPs will contain the following sections:

*Scope and Application*
*Definitions*
*Equipment*
*Documentation and Forms*
*In-house Modifications to Referenced Method*
*Procedures*
*Review*
*Quality Control*
*Corrective Actions*
*Miscellaneous Notes and Precautions*
*Method References*
*Appendices*

SOPs will be monitored through the laboratory document control system. Each SOP will be assigned a document control number as detailed in Section 5.2 of this LQAP. SOPs are revised whenever a laboratory procedure is changed or modified. All SOPs are reviewed and revised as necessary at least once a year. Personnel normally performing the procedure or analysis perform the review. SOPs will be generated for each new procedure implemented within the laboratory. Review, modification, new SOP generation, and distribution will be coordinated through the QAPM. The QAPM will periodically audit the laboratory sections to verify that the most current versions of all SOPs are in use. Document release will be controlled as detailed in section 5.2.

### 8.4 Method Selection and Use

Method selection will be based on availability of analytical instruments and equipment, chemical standards, expected method performance and marketability. Methods that are defined and accepted by regulatory agencies and familiar to ARI's clients are preferred. The Laboratory Manager and QAPM in consultation with marketing, client service, and laboratory supervisory staff are responsible for selecting appropriate methods. Client or project-specific methods may be used when appropriate.

The most recently promulgated method will be used for all procedures. Non-promulgated methods will be investigated if requested by a client. Section supervisors and managers are responsible for ensuring that the procedures in use reflect the requirements of the promulgated methods. Any modifications made to the method must be documented in the SOPs. Method modifications may be acceptable, provided all acceptance criteria specified in the method are met.

Section supervisors and managers review newly promulgated methods. SOPs will be modified as necessary to reflect the new methods. When possible, the annual SOP review will be coordinated with anticipated method promulgation dates. This is especially useful for large method compilations, such as SW-846. If the annual SOP review and method promulgation cannot be coordinated, SOPs will be revised as soon as possible after a method has been promulgated, especially when method changes are significant.

SOPs will be generated to reflect the most commonly used methods and protocols. If more than one method is used for an analysis, separate SOPs should be generated. Several methods may be incorporated into one SOP, provided that each method is clearly identified and defined in the SOP. Method modifications or special requirements for ongoing projects, or for specific programs (Navy, CLP, etc.), will be incorporated into the SOP. These requirements will be annotated to indicate that they are project/program specific. Analysts and technicians will be responsible for ensuring that, when required, project or program specific procedures are followed. SOPs will be controlled as specified in section 5.2.

## 8.5 Method Performance

Method performance must be demonstrated for all new methods prior to using methods for sample analysis. Section supervisors and managers are responsible for ensuring that method performance is demonstrated and support procedures have been performed.

Method performance will be demonstrated in the following manner:

A draft SOP will be generated for the method. The SOP must provide sufficient detail to perform the analysis and must accurately reflect the published method. Any steps in the method for which analyst discretion is allowed must be clearly defined.

A method detection limit (MDL) study must be performed for the method. Method detection limits must be verified to be at or lower than any method-specified detection limits. Method detection and reporting limits must be established.

Method precision and accuracy must be evaluated. This may be determined using an MDL or IDL study. Replicates will be evaluated for precision; analyte values will be compared to spike amounts to determine accuracy. Any method-specified precision and accuracy criteria must be met.

All method performance results will be reviewed and compiled by the section supervisor. Results will be filed with the QA section. A final SOP will be generated and distributed.

# SECTION 9: INSTRUMENT CONTROL

## 9.1 Detection Limits

To verify that reported limits are within instrument and method capabilities, three levels of detection have been established: instrument detection limits, method detection limits, and reporting limits. Instrument and method detection limits are statistically based values, determined from replicate analyses of analytical standards. Reporting limits are based upon the experience and judgment of an analyst. Reported values will be qualified based on the established limits. All limits will be summarized and controlled by the QAPM and are included as Appendix I.

Instrument Detection Limits

The instrument detection limit (IDL) is considered to be the smallest signal above background noise that an instrument can reliably detect. This limit reflects whether or not the observed signal has been caused by a real signal or is only a random fluctuation of noise from the blank. The IDL does not take into consideration the performance or efficiency of analytical methods.

Instrument detection limits are determined annually, or when ever a major change has been made, for each instrument in the metals analysis laboratory. Seven replicates, of a blank, or standards containing analytes at levels three to five times the expected IDLs are analyzed on three non-consecutive days. The IDL value for an analyte is three times the average of the standard deviations from the three replicate sets of analyses.

Method Detection Limits

The method detection limit (MDL) is considered to be the lowest concentration of an analyte that a method can detect with 99% confidence. Method detection limits will be established for all analytical parameters according to the guidelines specified in the Code of Federal Regulations, Section 40. Seven replicate samples are fortified with target analytes at levels that are one to five times (but not exceeding 10 times) the expected detection limits. The MDL for an analyte is determined to be the standard deviation of the replicates times the appropriate student's t-test value. More than seven replicates may be processed, but all replicates must

be used in the MDL determination. To report data without qualification, statistically determined MDLs cannot exceed any method specified MDLs.

Laboratory supervisors or managers review all statistically determined MDLs for accuracy and validity. The section supervisor or manager is responsible for ensuring that any unusable MDL studies are reprocessed. Once accepted, MDL study results and associated raw data will be forwarded to the QA section for further review and additional approval. MDLs approved by both section management and QA will be considered final and acceptable for use. Finalized MDL values are forwarded to Computer Services for incorporation into ARI's LIMS.

MDL studies will be conducted for all analyses performed by the laboratory on representative water, sediment and, tissue samples when appropriate and suitable sample matrices are available. MDL studies for inorganic analyses are only performed on aqueous samples. MDL studies will be performed on all instruments used for sample analysis. To allow for reevaluation of method performance, MDL studies will be performed on an annual basis. The QAPM is responsible for ensuring that all MDL studies are performed at least annually. Section supervisors and managers are responsible for determining if and when additional MDL studies should be performed due to changes in analytical methods, instrumentation or personnel.

## Reporting Limits

Reporting Limits (RL) are the lowest quantitative value routinely reported. Analytical results below the RL will be expressed as "less than" the reporting limit. RLs are estimated values based upon the MDLs, experience and judgment of the analyst, method efficiency, and analyte sensitivity. No reporting limit will be lower than its corresponding MDL. RLs will be verified on a regular basis either by having a calibration standard at the limit or by analyzing a standard at the RL immediately following initial calibration.

## Analytical Standards

Generation of high quality results is dependent upon the use of accurately prepared analytical standards. Many stock standards used within the laboratory are commercially prepared solutions with certified analyte concentrations. Neat standards used for stock standard

preparation are of the highest purity obtainable. Standard preparations are fully documented in appropriate logbooks.

Responsibilities

It is the responsibility of each laboratory employee involved with standards preparation to ensure that all standards are correctly and accurately prepared through the use of good laboratory practices and analytical verification. It is also the responsibility of these staff members to properly document the receipt and/or preparation of all standards. Management is responsible for ensuring that all staff members follow specified standards preparation and inventory procedures. The QAPM is responsible for periodically auditing standard preparation records to verify compliance with the laboratory Quality Assurance Program.

Organic Standards Preparation

Two types of standards are utilized for extractable organic compounds: neat standards from which stock solutions are prepared, and commercially prepared stock solutions from which working solutions are prepared. The type of standard depends upon availability. Commercially prepared standards are preferred when available.

Preparation of stock solutions will be documented in the Stock Solutions Log. To ensure traceability, commercially prepared stock solutions will also be documented in the Stock Standard Solutions Log. Each solution will be assigned a unique stock number determined by the page number and entry number on the page, preceded by “S” to indicate the solution is a stock, volatile stock standard are labeled “VS”. For example, the third entry on page 44 will be assigned the stock number S44-3. For stock solutions prepared from neat standards, the compound, supplier, lot number, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst should review the preparation information to verify accuracy. For commercially prepared stock solutions, the compound, supplier, lot number and expiration date will be recorded. As a stock solution is not actually prepared in-house for these commercial solutions, it is not necessary to record or verify a preparation schematic.

Preparation of working solutions (including spike and surrogate solutions) will be documented in the Working Standard Solutions Logbook. Each solution will be assigned a working

standard number determined by the page number and entry number on the page. For example, the second entry on page 73 will be assigned the working standard number 73-2. For volatile organic standards, the working standard number is preceded by "VW". The compound, stock solution reference, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst will review the preparation information to verify accuracy. After analyzing the standard and confirming that it is acceptable, analytical verification will be documented in the logbook.

Discarded or consumed standards will be annotated in the logbook by drawing a single line through the entry, indicating "discarded" or "consumed" above the line with confirming initial and date. Existing standard numbers will not be reused. Instead, each new stock or working solution made will be assigned a new number.

Standards preparation will be performed in accordance with good laboratory practices. Syringes, glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Neat standards that are less than 97% pure must be corrected for concentration. Standard solutions will be stored in amber bottles with Teflon-lined caps. Each standard solution will be labeled with the solution number, compound, analyst initials and expiration date. Stock solutions will be stored in the appropriate standards freezer; working solutions will be stored in the appropriate standards refrigerator.

Metals Standard Preparation

Commercially prepared single element stock solutions are used for all elements. Preparation of working solutions from these single element stocks will be documented in the Solutions Logbook. Preparation of check standards will also be documented in the Solutions Logbook. The element, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. Working calibration standards are prepared weekly for furnace and ICP analyses and as needed for ICP-MS. Calibration verification standards are prepared daily for GFA analyses and as needed for ICP and ICP-MS analyses.

Standards preparation will be performed in accordance with good laboratory practices. All preparation equipment will be thoroughly cleaned prior to and after use.

Inorganic (Wet Chemistry) Standard Preparation

Working standards for wet chemistry parameters will be prepared on a daily basis, prior to starting an analysis. Stock and check standard solutions will be replaced as solutions expire or are consumed. Stock and check standard solutions will be labeled with the compound, preparation data (weight and volume), units of concentration, preparation date, expiration date, and analyst initials.

Standards preparation will be performed in accordance with good laboratory practices. Glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Stock standards will be stored in containers appropriate for the parameter.

**9.3 Calibration**

Instrumentation and equipment used for sample processing and analysis must be operating optimally to ensure that accurate analytical results are generated. Verification of optimum operation is accomplished through various tuning and calibration procedures. Criteria for determining the accuracy of calibration are specified for all instrumentation and equipment. Prior to sample analysis, calibrations will be analyzed and evaluated against specified acceptance criteria. Acceptance criteria are either published as part of the method or generated at ARI using control charts. Calibration verifications will also be analyzed throughout an analytical sequence to ensure that instrument performance continues to meet acceptance criteria.

**Gas Chromatography/Mass Spectrometry (GC/MS)**

All GC/MS systems will be evaluated through analysis of an instrument performance check solution and calibration standards. The composition of the standards varies depending on the analysis performed on the system. System evaluation will be performed prior to sample analysis. Evaluation criteria used for GC/MS analyses are as specified for the SW846 methods.

> Instrument Performance Check Solution - Prior to analysis, the system will be evaluated to ensure that mass spectral ion abundance criteria are met. Bromofluorobenzene (BFB) is analyzed for volatile organic analyses and

Decafluorotriphenylphosphine (DFTPP) is analyzed for semi-volatile organic analyses. All ions must meet method-specified criteria.

The instrument performance check solution will be analyzed at a minimum of every 12 hours during the analytical sequence. Each analysis of the check solution will be verified against the specified criteria.

Calibration - After instrument performance has been verified, each GC/MS system will be calibrated to verify response linearity. For volatile organic analyses, up to eight standards ranging from 1 to 200 µg/L will be analyzed. For semi-volatile organic analyses, five to seven standards ranging from 2 to 80 µg/L will be analyz. The standard levels evaluated will vary depending on the compound. Initial calibration results will meet percent relative standard deviation acceptance criteria.

A continuing calibration verification standard at a mid-level concentration (routinely 50 µg/L for VOA and 250 µg/L for SVOA) will be analyzed at a minimum of every 12 hours during the analytical sequence. For continuing calibrations, minimum response factor and percent difference criteria will be considered in evaluating the acceptability of the calibration. Initial and continuing calibration acceptance criteria for volatile and semi-volatile organic analyses are presented in Appendix J. All calibration data printouts will include the following documentation:

*Date of calibration,*
*Identification of standard used*
*Identification of person performing the calibration*

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will also note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated. These results will be kept on file with the raw data in the Data Services section.

Internal Standard Responses - Internal standard responses and retention times in all standards will be evaluated immediately after analysis. This will serve as a baseline from which all sample internal standard responses and retention times will be evaluated.

Gas Chromatography (GC)

Each GC and HPLC system will be calibrated to verify response linearity. Depending on the parameter, five to seven standards at concentrations covering the linear range of the instrument will be analyzed. Percent relative standard deviations for initial calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

A continuing calibration standard at mid-range concentration will be analyzed after every 10 samples or more frequently if the method or conditions warrant. Percent differences between

initial and continuing calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

Calibration for organochlorine pesticides will follow SW-846 guidelines. The initial calibration sequence specifies the analysis of Resolution Check, Performance Evaluation, five-point initial calibration, individual standards and instrument blanks. Criteria for evaluating these standards are as follows:

> Performance Evaluation - The Performance Evaluation standard will be analyzed immediately following the Resolution Check standard. All standard peaks will be completely resolved. Individual breakdowns of DDT and Endrin will be less than or equal to 15% on both columns. A Performance Evaluation standard will also be analyzed at the end of the calibration sequence.
>
> Initial Calibration - An initial calibration consisting of levels of standard concentrations will be analyzed immediately following the analysis of aroclor 1660 curve and individual aroclor and Toxaphene standards. The percent relative standard deviation (RSD) will not exceed SW-846 guidelines or 20% on each column.
>
> Continuing Calibration - A midpoint Aroclor 1660 and or a midpoint pesticide standard along with a performance evaluation standard are analyzed after every ten (10) sample analyses. The continuing calibration standards will be within 85 - 115% of the initial calibration. The Performance Evaluation standard will meet previously specified criteria.

The analytical sequence may continue indefinitely, provided that calibration criteria are met throughout the sequence. Additionally, retention times for all compounds will fall within the retention time windows established by the initial calibration sequence of the three standard concentration levels.

All calibration data printouts will include the following documentation:

> *Date of calibration,*
> *Identification of standard used, and*
> *Identification of person performing the calibration.*

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated.

Metals

Analytical instrumentation for metals will be evaluated through the analysis of calibration standards, calibration blanks, and calibration verification standards. Initial calibrations will be performed prior to sample analysis.

**Inductively Coupled Plasma Atomic Emission Spectrometry (ICP)**

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards with a single concentration for each analytical wavelength. The calibration is immediately verified with the analysis of an initial calibration verification standard (ICV) obtained from a source independent from the IC standard. The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±2 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using standards of increasing concentrations. These standards are analyzed against the normal calibration curve and must be within 10% of their true value to verify linearity. At a minimum this upper range will be checked every six months or whenever major changes are made to the instrument. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

**Atomic Absorption Spectroscopy (Graphite Furnace and Cold Vapor)**

Atomic absorption instrumentation is initially calibrated using a minimum of three standards of varying concentrations and a calibration blank. Initial calibration is performed daily or more frequently if conditions warrant. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The initial calibration verification standard

value will be within ± 10% of the true value whereas the CCV will be considered in control if it is within ±10% for Graphite Furnace analysis or ±20% for Cold Vapor analysis.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected. Any sample determined to have a concentration above the high calibration standard will be diluted and reanalyzed.

**Inductively Coupled Plasma Mass Spectrometry (ICP-MS)**

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using high level standards. These standards are analyzed daily, or as necessary, against the normal calibration curve and must be within 10% of their true value to verify linearity. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

**Inorganic Analyses other than Metals (Conventional Analyses)**

Instrumentation and equipment used in analyzing samples for conventional wet chemical parameters (predominantly inorganic anions and aggregate organic characteristics) will be evaluated through the analysis of either internally prepared primary standards or externally derived Standard Reference Materials.

Depending upon the analysis, calibration is based upon direct stoichiometric relationships, regression analysis, or a combination of the two. Stoichiometry generally involves standardization of a titrant against a known primary standard and then the use of that titrant for determining the concentration of an unknown analyte (e.g. the use of sodium thiosulfate in the iodometric titration of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between analyte concentration and the response produced by the measurement being employed. Regression analysis is used for colorimetric determinations, ion specific electrode analysis and ion chromatography. The curve of response versus concentration is fit by the method of least squares using linear, polynomial or logarithmic regression dependant upon the pattern of response being measured.

Calibration is repeated for each analytical batch. Immediately following calibration, the standardized titrant or the calibration curve will be verified by the analysis of an Initial Calibration Verification standard (ICV) and Initial Calibration Verification Blank (ICB). The verification standard will be derived from a source other than that used for standardization or development of the standard curve. The ICV must return a value within 10% of its known concentration. The ICB must be less than the Reporting Limit (RL) or the lowest point on the standard curve, whichever is less. Initial calibration verification must be successfully completed prior to the analysis of any samples.

Calibration verification will be repeated after every ten samples processed during an analytical run. This Continuing Calibration Verification (CCV) will validate the method performance through an analytical sequence. If the continuing calibration values for either the standard or blank are out-of-control, the analyst will verify the outlying condition and, if verified, the analysis will stop and the method will be re-calibrated. All samples run between the outlying CCV and the preceding in-control CCV will be re-analyzed. In-control verification standards and blanks must bracket all samples within an analytical run.

Initial calibration depending upon the analysis is based on either a direct stoichiometric relationship, a linear regression analysis or a combination of the two. Stoichiometry generally involves standardization of a titrant and use of that titrant for determining the concentration of an unknown analyte (e.g. the use of thiosulfate in iodometric determination of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between the analyte concentration and the response produced by the measurement being employed. The curve is fit by the method of least squares using a linear, polynomial or logarithmic regression depending on the response being measured. The regression coefficient will be greater than or equal to 0.995 for the calibration to be considered acceptable.

Initial calibration curve is verified throughout the analytical sequence by analyzing a calibration verification standard after every 10 sample analyses. The calibration verification standard value will be within ± 10% of the initial calibration.

After initial calibration, a calibration blank will be analyzed to determine target analyte concentration levels. The level of analyte detected in the calibration blank will be less than the lowest standard concentration in the initial calibration.

# SECTION 10: DATA VALIDATION and REVIEW

One hundred percent (100%) of laboratory data generated at ARI are subjected to a four level validation (review) process prior to release from the laboratory. The four levels of review are:

1. Analyst review
2. Peer review
3. Supervisory review
4. Administrative review

The data review process is outlined below and detailed in SOPs 200S through 206S.

In addition, Quality Assurance Personnel review 10% or more of all completed data packages for technical accuracy, project compliance and completeness. The data validation outlined below is completed in addition to the initial project review explained in Section 7 and QA specific reviews outlined in Section 11. If it is determined at any point during the analysis, reporting, or review process that data are unacceptable, prompt and appropriate corrective action must be taken. The corrective action will be determined by the situation. It is the responsibility of all staff members involved in data reporting and review to be aware of the quality control requirements and to be able to identify occurrences that require corrective action.

**Analyst review:**

Each analyst is responsible for producing quality data that meets ARI's established requirements for precision and accuracy and is consistent with a client's expectation.

Prior to sample preparation or analysis an analyst will verify that:

1. Sample holding time has not expired.
2. The condition of the sample or extract is described accurately on the laboratory bench sheet.

3. Specified methods of analysis are appropriate and will meet project required Data Quality Objectives.
4. Equipment and Instrumentation are in proper operating condition.
5. Instrument calibration and/or calibration verification are in control.

During sample preparation or analysis an analyst will:

1. Verify that Method Blanks and Laboratory Control Samples are in control.
2. Verify that QC (replicate, matrix spike analyses, SRM, etc.) samples meet precision and accuracy requirements.
3. In addition to verifying that quality control requirements are met, the analyst will review each sample to determine if any compound of interest is present at levels above the calibrated range of the instrument.
5. Check for data translation or transcription errors
6. Record all details of the analysis in the appropriate bench sheet or logbook.
7. Note any unusual circumstances encountered.

Following the analysis or sample preparation an analyst will:

1. Examine each sample and blank to identify possible false positive or false negative results.
2. Determine whether any sample requires reanalysis due to unacceptable quality control.
3. Review data for any unusual observances that may compromise the quality of the data, such as matrix interference
4. Review and verify that data entry and calculations are accurate and no transcription errors have occurred.
5. Document anomalous results or other analytical concerns on the bench sheet, corrective action form or Analyst Notes for incorporation into the case narrative.
6. Note data with qualifying flags as necessary.

7. Enter reviewed data into LIMS as appropriate, incorporate all necessary sample and quality control information into the data package and forward it for further review.

**Peer review:**

A second analyst trained in the appropriate SOPs will complete a peer review. Peer review will include at a minimum:

1. Verification that all QA (holding times, calibrations, method blanks, LCS, spiked sample analyses, etc.) criteria are in control.
2. Examination the data for possible calculation and transcription errors.
3. Review bench sheets and analyst notes for completeness and clarity.
4. Approve the analytical results or recommend corrective action to the laboratory supervisor.

When a second trained analyst is not available a peer review is not completed.

**Supervisory Review:**

Following analyst and peer review the data is forwarded to the laboratory section supervisor for review. The supervisor will:

1. Review the data package for completeness and clarity.
2. Follow-up on the peer review recommendations.

Designated reviewers normally perform the peer and supervisory reviews for GC-MS data. The reviewers are identified on the organizational chart in Appendix A.

**Administrative Review:**

The results of all analyses are reviewed for compliance with quality control criteria and technical correctness before data is released to the Project Manager for distribution to clients. Designated reviewers in the Metals, Conventional and Organic laboratories perform administrative reviews. Personnel responsible for administrative reviews are noted in the Organizational Chart in Appendix A to this LQAP.

Administrative review is the final data validation process. Personnel performing the administrative review are responsible for the final sign-off and release of the data. Following administrative review the data is released to Project Managers for incorporation into the final data deliverable package.

Administrative review will:

1. Verify that the analytical package submitted for reporting is complete and contains all necessary information and documentation.
2. Verify that appropriate and necessary data qualifying flags (Listed in Appendix N) have been used.
3. Verify that method blank and LCS data are acceptable, quality control requirements were met for surrogates in all samples and blanks, and that all necessary re-analyses or dilutions were performed.
4. Check the technical validity (i.e. are total metal > dissolved metals, is the cation/anion balance correct, etc.) of the complete data set.
5. Verify that all necessary final data reports have been generated and that all necessary data and documentation are included in the package.
6. Approve data reports for release.

## 10.2 Quality Assurance Review

10% (1 out each 10) final data packages are reviewed by ARI's QA staff for compliance with ARI's QA Program. This assessment includes, but is not limited to, review of the following areas:

1. Reporting and analysis requirements
2. Initial and continuing calibration records
3. Quality control sample results (method blank, LCS, spikes, replicates, reference materials)
4. Internal and surrogate standard results
5. Detection and reporting limits
6. Analyte identifications.

Data review activities are summarized and documented by the reviewer. The review notes are filed with the associated raw data in the project file. Any QA-related deficiencies identified during the data review will be forwarded to the QAPM for corrective action.

# SECTION 11: QUALITY CONTROL SAMPLE ANALYSIS AND EVALUATION

Routine analysis of quality control (QC) samples is necessary to validate the quality of data produced in the laboratory. ARI routinely analyses the following quality control samples: method blank (MB), holding blank (HB), laboratory control sample (LCS), matrix spike (MS) and sample replicate (MD or MSD). Section 11.3 defines these QC samples. The number and type of QC analyses depend on the analytical method and/or the QA/QC protocol required for the analyses. An expected result has been defined for each type of QC analysis. If quality control sample results meet all specified criteria, the analysis is considered to be "in-control" and the data acceptable. Conversely, quality control sample results that do not meet the specified criteria indicate that the procedure may not be generating acceptable data and corrective action may be necessary to bring the process "in-control".

In addition to QC analyses, ARI routinely uses surrogate standards to measure the efficiency of all analyses targeting organic analytes.

Detailed information concerning sample preparation batches, QC analyses and surrogate standards follow:

## 11.1 Sample Preparation Batch

All QC samples will be associated with a discrete sample preparation batch. A preparation batch is defined as 20 or fewer field samples of similar matrix processed together by the same analysts, at the same time, following the same method and using the same lot of reagents. Additional batch requirements are detailed in ARI's method specific standard operating procedures. Each preparation batch will be uniquely identified. All samples, field and QC, will be assigned an ARI LIMS ID number and will be linked to their respective preparation batch. Each sample batch will contain all required QC samples in addition to a maximum of twenty field samples.

ARI will accommodate client, QC protocol or QAPP specific sample batching schemes.

## 11.2 QC Sample Requirements

Each preparation batch will include, at a minimum, a method blank (MB) and a laboratory control sample (LCS). Additional QC samples will be analyzed based upon the specific QC protocol required, data deliverable requirements or client request. ARI recommends that QC samples used to measure analytical precision also be included in each sample batch. These may include: a matrix spike and a matrix spike duplicate pair; a sample duplicate and a matrix spike pair or an LCS duplicate (LCSD) for comparison with the LCS.

## 11.3 QC Sample Definitions

### 11.3.1 Method Blank (MB)

A method blank is an aliquot of water or solid sample matrix that is free of target analytes and is processed as part of a sample batch. The MB is used to verify that contaminants or compounds of interest have not been introduced into samples during laboratory processing. MBs will be spiked with surrogate standards for all organic analyses.

ARI defines an acceptable MB as one that contains no target analytes at a concentration greater than one-half ARI's reporting limit or 5% of an appropriate regulatory limit or 10% of the analyte concentration in the sample which ever is greatest.

A minimum of one method blank will be included in each preparation batch. A maximum of twenty samples may be associated with one method blank. An acceptable MB is required prior to analysis of field samples from a preparation batch. For methods not requiring pre-analysis sample preparation, a minimum of one method blank will be analyzed immediately prior to sample analysis, periodically throughout the analytical sequence, and also at the end of the sequence.

The results of the MB analysis will be reported with the sample results.

### 11.3.2 Holding Blank (HB)

Holding blanks are organic-free water samples that are placed in each volatile organic sample storage refrigerator to monitor for possible cross-contamination of samples within the storage units. A holding blank from each refrigerator will be analyzed every 14 days. Holding Blank

analyses will be reviewed by laboratory management and archived in ARI's electronic document archive.

### 11.3.3 Laboratory Control Sample (LCS)

An LCS is processed as part of each preparation batch, and is used to determine method efficiency. An LCS is an aliquot of water or solid matrix free of target analytes to which selected target analytes are added in known quantities. The analytes spiked into LCS samples are listed in ARI's method specific SOPs. LCS will be spiked with surrogate standards for all organic analyses.

Following analysis the percent recovery of each added analyte is calculated and compared to historical control limits. Current control limits are listed in Appendix K of this document. When calculated recovery values for all spiked analytes are within specified limits, the analytical process is considered to be in control. Any recovery value not within specified limits requires corrective action prior to analysis of any field samples from the associated preparation batch.

A minimum of one LCS will be prepared for each sample preparation batch. LCS analysis for those methods not requiring pre-analysis sample preparation will be performed after each continuing calibration. The results of all LCS performed will be reported with the sample results. A maximum of twenty samples may be associated with one LCS.

Specific clients or QA protocol may require the analysis of a duplicate LCS. When LCS duplicates are analyzed the failure of any analyte in either LCS to meet QC limits must trigger a corrective action.

### 11.3.4 Replicate Analysis

Replicate analyses are often used to determine method precision. Replicates are two or more identical analyses performed on subsamples of the same field sample at the same time. Replicate analyses should be performed on samples that are expected to contain measurable concentrations of target analytes.

The calculated percent difference between replicates must be within specified limits or corrective actions are required. Percent differences exceeding the specified limit signal the

need for procedure evaluation unless the excessive difference between the replicate samples is clearly matrix related.

For inorganic analyses, a minimum of one replicate set should be processed for each analytical batch. Replicate sample analyses are not routinely performed for organic parameters. Instead, analytical precision is evaluated through the analysis of a duplicate matrix spike sample (MSD).

In order to perform replicate analyses, ARI's must receive sufficient volume to prepare the replicate aliquots.

Field replicates submitted to the laboratory will be analyzed as discrete samples.

### 11.3.5 Matrix Spike

A matrix spike is an environmental sample to which known quantities of selected target analytes have been added. The matrix spike is processed as part of an analytical batch and is used to measure the efficiency and accuracy of the analytical process for a particular sample matrix. The analytes spiked into MS samples are listed in ARI's method specific SOPs. MS samples will be spiked with surrogate standards for all organic analyses.

Following MS analysis the percent recovery of each spiked analyte is calculated and compared to historical control limits. If recovery values for the spiked compounds fall within specified limits, the analytical process is considered to be in control. When calculated recovery is outside of historical limits corrective action is recommended.

Matrix spike duplicate (MSD) analyses are often used to measure method precision and accuracy. In this case the relative percent difference for recovery of spiked compounds is calculated and compared to established criteria.

Unless directed otherwise, ARI's policy is to prepare a matrix spike and a duplicate with each batch of samples for inorganic analysis and an MS/MSD set for each batch of samples for organic analyses. Analyte recovery and RPD values are reported with sample data.

### 11.3.6 Standardized Reference Material (SRM)

An SRM is material analyzed and certified by an outside organization to contain known quantities of selected target analytes independent of analytical method. SRMs are normally purchased from outside suppliers outside of ARI and are supplied with acceptance criteria. Analysis of SRM is used to assess the overall accuracy of ARI's analytical process. SRM are routinely analyzed with each batch of samples for wet chemistry (conventionals analysis) samples. External reference samples are analyzed after instrument calibration and prior to sample analysis. Compound recovery values not within the specified limit signal the need to evaluate either the calibration standards or instrumentation.

### 11.3.7 Other Quality Indicators

In addition to analyzing the quality control samples outlined previously, various indicators are added to environmental samples to measure the efficiency and accuracy of ARI's analytical process. Surrogate standards are added to extractable organic samples prior to extraction to monitor extraction efficiency. Surrogate standards will also be added to volatile organic samples prior to analysis to monitor purging efficiency. Internal standards are added to metals digestates for ICP-MS analyses and to organic samples or extracts prior to analysis to verify instrument operation.

The calculated recovery of surrogate analytes is compared to historical control limits to aid in assessing analytical efficiency for a given sample matrix.

## 11.4 Control Limits

To provide a means for evaluating whether or not a process is in control, acceptance limits have been established. These are based on internal, historical data for organic analyses and method specified limits for inorganic analyses. Samples associated with a specific program or contract (such as the USEPA Contract Laboratory Program) will be evaluated against program/contract-specified criteria. Routine samples will be evaluated against internally generated control limits. Project specific control limits will be used as required provided they have been reviewed for feasibility and approved by laboratory management.

Results of QA analyses are transferred from the LIMS to a control limit and chart generation program. The QAPM coordinates control chart and control limit generation. Control limits will

be generated for LCS compound recoveries, surrogate recoveries, and matrix spike compound recoveries, on a method and matrix specific basis. Advisory control limits will be utilized for analyses performed on an infrequent basis until a sufficient number of usable data points are collected. Control limits are updated at least annually, but may be updated more frequently if method or instrument changes have been made. Laboratory control and acceptance limits are detailed in Appendix K.

Two levels of control limits are utilized in evaluating process control: warning limits and action limits. Limits are statistically determined from values obtained from LCSs or other control samples. Warning limits, within which 95% of all results are expected, equal ± two standard deviations from the average result. Action limits, within which 99.7% of all results are expected, are equal to ± three standard deviations from the average result. Mean values, warning limits, and action limits are necessary for thorough evaluation of process control.

### 11.5 Control Charts

Control charts, in conjunction with other control sample analyses, are useful in verifying that an analytical procedure is performing as expected. The control chart provides a pictorial representation of how closely control sample results approximate expected values, as well as showing analytical trends. Indicated on the control chart are the mean and upper and lower warning and action limits. The warning and action limits are used to determine whether or not an analytical process is in control. The mean is used to determine whether results obtained for a procedure are trending upward or downward, which may ultimately affect the accuracy of sample results.

The QA Officer will coordinate generation of control charts based on laboratory data at least semi-annually. These control charts will be distributed to and reviewed by section supervisors and managers. Any significant trends or variations in results will be identified, and the source of the trend corrected. Copies of control charts will remain on file in the QA section. At the bench/instrument level, individual results from quality control samples are evaluated against the limits.

# SECTION 12: CORRECTIVE ACTIONS AND REESTABLISHMENT OF CONTROL

To produce quality data, it is important that all aspects of the analytical process are under control and that all specified quality control criteria are met. On occasion, however, procedures, reagents, standards, and instrumentation can fail to meet specified criteria. Should any of those situations occur, the quality of data produced may be compromised. When procedures no longer appear to be in control, sample processing will be halted and appropriate actions will be taken to identify and rectify any instrument malfunctions or process-related issues. Prior to resuming sample analysis, verification of control will be made through the analysis of various control samples. Actions taken and observations made during reestablishment of control will be fully documented on the bench sheet or as an Analyst Note. Only when control has been regained and all actions documented will sample processing resume. This ensures that no results generated during the suspect period will be reported.

## 12.1 Responsibilities

It is the responsibility of all laboratory personnel involved with sample processing to be able to determine whether or not a procedure is in control and to verify that all data are produced under conditions that are “in control”. It is at the analytical level that unacceptable conditions are most easily detected and addressed. These personnel are also responsible for employing and documenting all necessary corrective actions taken to regain control of a procedure. Samples processed during suspect periods will be reprocessed, and suspect data will be appropriately annotated to indicate that it is of questionable quality. The analytical staff will verify that all data submitted for review has been generated under acceptable conditions. All anomalies will be documented on the Analyst Notes form and will include such information as: type and source of anomaly, reasons for the anomaly, and actions taken to correct the problem. All personnel involved with subsequent and final data review are responsible for verifying that data were generated under acceptable conditions. If suspect data are identified at the review level, responsible analysts should be contacted to determine whether additional actions (such as reanalysis) will be taken. In addition, reviewers will confirm that anomalies

noted by the analyst were indeed addressed and that appropriate corrective actions were taken.

On occasion, it is not possible to generate data that meet all Quality Control Standards. This may be due to sample volume limitations or sample matrix effects. It is the responsibility of the analytical and data review staff to document these situations and to maintain communication with the Project Management staff. The Project Management staff, in turn, is responsible for notifying the client or specifying additional actions to be taken. Project Managers are further responsible for ensuring that clients fully understand which data are questionable and the reasons why acceptable results could not be generated.

It is the responsibility of the QAPM to perform regular reviews of corrective action procedures to ensure that unacceptable conditions or suspect data will be identified prior to releasing results. Section managers and supervisors are responsible for ensuring that appropriate corrective action procedures are in place and that all staff members are trained to identify and act upon “out of control” situations.

### 12.2 Corrective Actions

There are various stages of the analytical process where the procedure may fall out of control and require corrective action. In general, all procedures and equipment will be monitored to verify that control is maintained during sample processing. The following details those stages as well as the actions taken to reestablish and verify control.

Sample Preparation

During sample preparation, all glassware associated with a specific sample will be clearly labeled to eliminate the possibility of sample mix-up or mislabeling. Laboratory staff will ensure that sample-identifying labels are accurately completed and that correct sample identification is maintained at all times. If a sample appears to have been misidentified or mixed with another sample during preparation, the suspect samples will be discarded and new aliquots taken. If there is insufficient sample for a second preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Addition of surrogate standards or matrix spiking solutions will be carefully monitored to ensure that all samples are accurately fortified. Volumes and standard solution numbers of all

standards added to samples will be recorded on the bench sheet. If there is suspicion that a sample has been incorrectly spiked a new sample aliquot should be prepared. If there is insufficient volume for re-preparation, the bench sheet will be annotated to indicate which samples may be inaccurately fortified.

If sample matrix hinders processing per standard procedures, the section supervisor or manager will be consulted for guidance on appropriate actions. Preparation of smaller sample aliquots or employment of different procedures may be necessary. Any deviations from normal protocols will be documented on the bench sheet.

If at any time during sample preparation sample integrity is compromised or a procedural error is noted, the sample will be discarded and re-prepared. If insufficient sample volume is available for re-preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Calibration and Tuning

Prior to sample analysis, all instrumentation will be calibrated and tuned to ensure that equipment meets all criteria necessary for production of quality data. Equipment must meet the calibration criteria specified in the section entitled “Calibrations”, per manufacturer specifications or per project/contract requirements. If these criteria are not met, corrective actions must be employed. Any corrective actions taken will be fully documented in the appropriate logbook, indicating the problem, the actions taken, and verification. Samples will not be analyzed until initial verification of system performance has been made. In the event that continuing calibration results do not meet criteria, sample analysis will not resume until corrective actions have been employed or the system has been re-calibrated.

GC/MS Analyses - Analysis of the instrument performance check solution (BFB or DFTPP) will meet the specified ion abundance criteria. Initial calibration standards at a minimum of five concentrations will meet specified response factor and percent relative standard deviation criteria. It criteria are not met for initial calibration, the system will be inspected for malfunction. The initial tuning and calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed at a minimum of once every 12 hours. All response factor criteria will be met. Additionally, the percent difference between the initial and continuing calibrations will meet specified criteria. If criteria

are not met, the system will be inspected for malfunction. The initial tuning and calibration verification will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

Internal standard responses and retention times for standards will meet specified criteria. Any sample not meeting internal standard criteria will be reanalyzed. If reanalysis yields the same response and the instrument is determined to be functioning correctly, the failure to meet criteria will be attributed to sample matrix interference. No further re-analyses will be required.

GC Analyses - Organochlorine pesticide calibrations will be evaluated using either USEPA CLP or SW-846 guidelines. The Resolution Check standard will meet resolution criteria and Endrin and DDT breakdown in the Performance Evaluation standard will meet breakdown criteria. Initial calibrations will meet percent relative standard deviation criteria. If, during the initial calibration sequence, criteria are not met, the system will be inspected for malfunction and the initial calibration be reanalyzed. Samples will not be analyzed until all initial calibration criteria are met.

Continuing calibrations of either the mid-level calibration standard or Performance Evaluation standard will be analyzed every 12 hours. If continuing calibration criteria are not met, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples previously analyzed between the acceptable and unacceptable continuing calibration will be reanalyzed.

If, during the analytical sequence, retention time shifting occurs, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples with retention times outside the specified windows will be reanalyzed.

For all other analyses, initial calibration standards analyzed at a minimum of five concentrations will meet percent relative standard deviation criteria. If criteria are not met for initial calibration, the system will be inspected for malfunction. The calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed after every 10 samples. All percent differences between the initial and continuing calibrations will meet specified criteria. If criteria are not met, the system will be inspected for malfunction and re-calibration will be performed. Samples analyzed between an acceptable and unacceptable calibration check will be reanalyzed.

Metals and Inorganic Analyses - Initial calibrations will be verified by analyzing a calibration check standard immediately after calibration. The percent differences between the initial calibration and calibration check standard will meet specified percent difference criteria. If criteria are not met, the system will be inspected for

malfunction. The initial calibration and calibration check will be reanalyzed until acceptance criteria are met.

The calibration check standard analyzed after every 10 samples will meet percent difference criteria. If the calibration check standard is not acceptable, the system will be inspected for malfunction and re-calibration will be performed as necessary. Samples analyzed between acceptable and unacceptable calibration check standards will be reanalyzed.

Instrument Blanks

Prior to sample analysis, instrument and/or calibration blanks may be evaluated for the presence of target analytes. If analytes are detected, the concentrations must be below the reporting limits for those analytes. If analytes are detected at levels above the reporting limits, the source of contamination will be identified. Sample analysis will not commence until analyte levels in instrument and calibration blanks are below the reporting limits. Instrument and calibration blanks are analyzed for VOA analysis only if sample carryover is suspected.

Instrument and calibration blanks will also be analyzed throughout the analytical sequence. These will not contain target analytes at levels above the method detection limits for organic parameters or the reporting limit for inorganic parameters. If one or more analytes exceed the RL, an additional blank will be analyzed. If analyte levels are still above the method detection limits, the system will be inspected for malfunctions and the source of contamination will be identified. Sample analysis will not resume until instrument and calibration blank analyte levels are below the RL. Organic samples analyzed between acceptable and unacceptable blanks will be evaluated to determine the need for reanalysis per the following guidelines:

If no target analytes are detected in the samples, reanalysis will not be required.

If sample target analyte levels are above the method detection limits, samples will be reanalyzed at analyst discretion. Reanalysis will be dependent upon the analyte levels and whether or not there is likelihood that analytes detected are a direct result of system contamination.

If the analytes present at unacceptable levels in the instrument blank are not of interest or concern in the associated samples, reanalysis will not be required. This is often a consideration for ICP analyses where analytes of concern may be only a subset of the possible analytes.

Methods for the analysis of inorganic analytes require that all samples associated with an out of control blank be re-analyzed.

Method Blanks

Prior to sample analysis, method blanks will be evaluated for the presence of target analytes. Ideally, no target analytes should be present in the method blank. If analytes are detected at or above the Reporting Limit, the method blank will be reanalyzed to verify that the contamination is not a result of instrument carryover or malfunction. If the presence of target analytes is confirmed, the concentrations must be below the RL for those analytes.

Several volatile and semi-volatile compounds and certain elements are considered to be common laboratory contaminants. Concentrations of these common laboratory contaminants may exceed the method detection limits, but may not be present at concentrations greater than five times the method reporting limits. Target analytes considered to be common laboratory contaminants are:

**Volatile Organic Compounds**

*Methylene Chloride*
*Acetone*
*2-Butanone*

*Semi-volatile Compounds*
*Dimethylphthalate*
*Diethylphthalate*
*Di-n-butylphthalate*
*Butylbenzylphthalate*
*bis-(2-Ethylhexyl) phthalate*
*Di-n-octylphthalate*

If target analyte concentrations in the method blank exceed the acceptable levels and instrument malfunction or contamination has been ruled out, the method blank and all associated samples will be re-prepared and reanalyzed. If there is insufficient sample volume remaining for reprocessing, the Project Manager will be notified. If it is necessary to report results associated with an unacceptable method blank, the results will be qualified to indicate possible laboratory contamination.

In the event that an analyte detected in the samples ≥ 20 times the method blank levels re-preparation and reanalysis is not required. It is assumed that any contamination in the method blank is insignificant and will not affect final quantified results.

Laboratory Control Samples

Prior to sample analysis, the laboratory control sample (LCS) will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If LCS recoveries are out of control, corrective action is required. Corrective actions may include anything from a written explanation in the case narrative up to re-preparation and reanalysis of the entire sample batch.

Internal Standards

For volatile and semi-volatile organic analyses, internal standard results will be evaluated after each analytical run to verify that the values are within acceptance limits. Internal standard values will be within -50% to +100% of the internal standard values in the continuing calibration. If any internal standard does not meet the criteria, the system will be evaluated to confirm that all instrumentation is operating properly. The sample will then be reanalyzed. If the reanalysis results do not meet acceptance criteria, it will be assumed that the sample matrix is affecting internal standard values. Further reanalysis will not be required.

Surrogate

Surrogate recovery values will be evaluated after each analytical run to verify that the values are within acceptance limits. If recovery values are outside acceptance limits, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of surrogate spike solutions added are accurate. For extractable organic analysis, bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system documentation, solution preparation or spiking errors are identified, the following considerations will be made:

When a volatile organic surrogate recovery value is outside of acceptable limits, the sample will be reanalyzed. If the reanalysis results are within acceptance limits, it will be assumed that the initial analysis was in error. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery. Further reanalysis will not be required.

For semi-volatile organic analysis, one acid and one base/neutral surrogate recovery may be outside acceptance limits with no corrective action required provided the recoveries are at least 10%. If more than one acid or base surrogate standard is outside acceptance limits, or if any surrogate recovery value is less than 10%, the sample will be re-extracted and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery assuming all other QC analyses are acceptable. Further reanalysis will not be required. *Matrix spikes will not be re-extracted for unacceptable surrogate recovery values.*

For other extractable organic analysis, if a surrogate recovery value is outside of acceptance limits, the data will be reviewed to determine if the unacceptable surrogate is a result of matrix effect. If matrix interference is determined, the sample will be re-extracted or if re-extraction is not deemed useful, fully documented in the analytical narrative associated with the analyses. If a surrogate recovery is too low, based on the opinion of the final QA Data Reviewer, the sample will be re-extracted and reanalyzed.

Matrix Spikes

Matrix spikes will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If unacceptable results are obtained, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

Organic Analyses:

If a matrix spike recovery value is outside the acceptance limits, but the LCS meets recovery acceptance criteria, re-extraction will not be required. It will be assumed that the unacceptable recovery value is a result of matrix effect.

If both LCS and matrix spike recovery values are outside the acceptance limits, the sample batch will be re-extracted and reanalyzed. This indicates the possibility of a systematic error that may affect the accuracy of final results.

Inorganic analyses:

Matrix spikes with unacceptable recovery values will be re-prepared and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that the sample matrix is affecting the recovery values. Further reanalysis will not be required.

A post-digestion spike analysis will be performed for all metals analyses processed following EPA-CLP guidelines.

Sample and Matrix Spike Replicates

Sample and matrix spike replicates will be evaluated to verify that percent differences between the replicates are within acceptable limits. Percent differences for metals and inorganic sample replicates will be within ±20%. When percent difference criteria are not met, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

If percent difference values between sample replicates for metals and inorganic analyses do not meet acceptance criteria the Project Manager in consultation with ARI's client will determine weather to re-analyze the samples or flag the analytical results. If the samples are reanalyzed and results are not within acceptance limits, it will be assumed that the sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Replicate sample analyses are not routinely performed for organic parameters.

If percent difference values between matrix spike replicates do not meet acceptance criteria, but spike recovery values are acceptable, no re-extraction or analysis will be required. It will be assumed that the sample is not homogeneous, causing the poor analytical precision.

If percent difference values between matrix spike replicates do not meet acceptance criteria and recovery values in one or both replicates are not acceptable, the sample and associated matrix spike replicates will be re-prepared and reanalyzed. If the

reanalysis results are not within acceptance limits, it will be assumed that the sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Samples

In addition to monitoring sample quality control indicators, samples will be evaluated to determine the need for reanalysis. The following conditions will be considered while evaluating samples:

If a target analyte detected in a sample exceeds the upper limit of the instrument calibration range, the sample will be diluted and reanalyzed. Dilution and reanalysis will be performed until the analyte concentration falls within the linear range of calibration. If the sample requires dilution to such a level that surrogates are no longer detectable and analytical accuracy is questionable, the sample will be re-prepared using a smaller sample aliquot.

Samples will be evaluated for matrix interference that may affect analyte detection and quantification. Appropriate cleanup procedures will be employed to remove interference. Samples will be diluted and reanalyzed as required to minimize background interference. If it is not possible to remove all interference, reported results will be qualified as necessary.

If low-level analytes detected in a sample are suspected to be a result of instrument carryover, the sample will be reanalyzed. If analyte levels remain approximately the same the initial results will be considered valid. If analytes are not detected during reanalysis, it will be assumed that the initial detection was due to carryover, and the initial results will not be reported.

If an instrument malfunction or procedural error occurs during analysis, all affected samples will be reanalyzed. If the malfunction appears to be an isolated incident, it will not be necessary to inspect the analytical system. If the malfunction appears to be an ongoing problem, the system will be inspected and necessary maintenance/corrective actions will be taken prior to resuming analysis.

Sample Storage Temperatures

Every sample storage unit's temperature will be evaluated at the beginning of each day. Temperatures will be between 2 and 6 °C for refrigerators and < -10 °C for freezers. If a temperature is outside the specified range, the unit's temperature will be adjusted to bring the temperature back within limits. The Temperature Log will be annotated to document the adjustment.

If adjustment does not bring the temperature within range, or if adjustment is not possible, the Laboratory Supervisor will be notified and will take corrective action. The Temperature Log will

be annotated to document the action. If the temperature fluctuation is chronic or extreme, the samples will be removed from the unit and placed in another storage unit until the malfunctioning unit is repaired or replaced.

Balance Calibrations

Balances are serviced once a year by a certified technician. The service includes preventative maintenance and calibration.

Balance accuracy will be verified prior to balance use. The recorded weight will be within the acceptance criteria specified on the Calibration Log. If the recorded weight is not within the acceptance limits, the QAPM will be notified. The Calibration Log will be annotated to document the action. The balance will not be used until it can be verified that acceptance criteria can be met.

Water Supply System

The water supply for the volatile organic and inorganic laboratories will be monitored daily for the presence of contaminants through the analysis of method and/or instrument blanks. Organic contaminants, especially chloroform, are early indicators of the need for preventative maintenance. If organic or other contaminants are detected, the system filters will be changed. After filters have been changed, an additional aliquot of water will be analyzed to confirm that contaminants are no longer present.

The water supply for the metals laboratory will be monitored daily. When the resistivity falls below 18 megaohm, system maintenance will be performed.

# Section 13: LABORATORY EVALUATION AND AUDITS

Routine evaluations of the laboratory ensure that all necessary quality control activities have been implemented and are being effectively utilized. It is the responsibility of the QAPM to ensure that quality control activities are periodically evaluated for compliance. Findings from these evaluations allow the laboratory to address and modify any procedures that are not in accordance with the laboratory Quality Assurance Program or accreditation program requirements.

A number of tools are available for monitoring laboratory performance. ARI evaluates the quality of laboratory performance through the use of

*Internal QA Audits*
*Technical System Audits*
*Data Quality Reviews*
*Audits by Outside Agencies (External Audits)*
*Performance Evaluation Analyses*

Each audit provides an objective evaluation of laboratory performance. All internal audits and reviews are conducted according to specified guidelines. In addition, a collective review of audit findings provides an overall evaluation of the laboratory. Deficiencies noted during the course of an audit or performance evaluation will be addressed, a root cause analysis performed, and appropriate corrective actions will be taken. Follow-up audits will be conducted to verify that corrective actions have been satisfactorily implemented.

Internal QA Audits

The Quality Assurance Officer regularly evaluates quality control activities within the laboratory to verify accuracy and compliance. The QAPM or designee routinely audits the following activities:

*Balance verification records*
*Sample storage cooler temperature records*
*Oven, incubator and water bath temperature records*
*Chain of Custody records*
*Standard preparation records*

Checklists are utilized to ensure consistent and complete audits. The checklists are included in SOP 1005S. Internal QA audit results will be summarized and reported to both staff and management. Corrective actions will be initiated as necessary. A schedule of internal QA audits is provided in Appendix L.

Technical System Audits

An audit of technical systems within the laboratory will be conducted at least annually. The audit will focus on the quality control and data generation/collection systems. The QAPM will conduct the audit with assistance from section managers and data reviewers. This evaluation will address areas such as:

*Calibration records*
*Maintenance records*
*Control charts*
*Computer vs. hard copy data*
*Adherence to SOPs and methods*
*Support system records (DI water, balances, pipettes, etc.)*

In addition, audit results from the past year will be reviewed to verify that all necessary corrective actions have been addressed and implemented.

Audits by Outside Agencies (External Audits)

As a requirement for many accreditation programs, on-site review of laboratory facilities and operations are conducted by clients or other outside agencies. The laboratory may be periodically audited by the following agencies:

USEPA Contract Laboratory Program
State of Washington Department of Ecology
State of Washington Department of Health
US Naval Facilities Engineering Service Center (NFESC) (formerly known as NEESA)
Hazardous Waste Remedial Actions Program (HAZWRAP)
US Army Corps. of Engineers

External audits are beneficial in that they provide an independent evaluation of the laboratory without internal influence or bias. The laboratory will be available for evaluation

at the convenience of the auditing agency. Laboratory personnel will be available during the audit to address questions or provide information regarding laboratory procedures. All comments, deficiencies, and areas of potential improvement noted by the auditor will be reviewed, and appropriate corrective actions will be taken to resolve the noted issues. A listing of laboratory accreditations is included as Appendix M.

Performance Evaluations

Performance Evaluation (PE) sample analysis is a means of evaluating individual performance as well as the overall analytical system. In addition to the external audit, PE sample (PES) analysis is a requirement of many certification and accreditation programs. The laboratory routinely participates in the following performance evaluation programs:

*Analytical Standards, Inc.(ASI) Performance Evaluation Studies*
*USEPA Water Pollution (WP) Performance Evaluation Studies (Commercial Supplier)*
*USEPA Water Supply (WS) Performance Evaluation Studies (Commercial Supplier)*
*USEPA Contract Laboratory Program Quarterly Performance Evaluations (as required)*

A PES is a sample containing specific analytes in concentrations unknown to analysts. Comparison of the laboratory result to the "true" value determines the accuracy of the reported result and indicates the laboratory's ability to perform a given analysis. These results are also used to verify individual analyst proficiency. The QAPM will periodically submit internal “blind” performance evaluation samples to the laboratory sections for analysis. Values obtained by the laboratory will be compared to expected or true values. Parameters with reported values outside of the specified acceptable ranges will be evaluated by the analytical staff to determine the source of error. All necessary corrective actions will then be documented and implemented.

Quality Assurance Reports to Management and Staff

In order to ensure that laboratory managers are kept apprised of quality related activities and laboratory performance, a “Quality Assurance Report to Management” the QAPM will

be produced annually and distributed to ARI management. The report will, at a minimum include:

1. Information concerning current and ongoing internal and external audits
2. Status and results of current or ongoing internal or external proficiency analyses
3. Identification of Quality Control problems in the laboratory
4. Information on all ongoing Corrective Actions
5. Current status of external certifications
6. Current status of the Staff Training Program
7. Outline of new and/or future Quality Assurance Program initiatives

The QAPM is responsible for follow-up and resolution of any deficiencies discussed in the report. Unresolved issues will remain on subsequent reports until addressed. Information such as performance evaluation results and audit reports will be distributed to the laboratory staff.

The application of these combined activities provides comprehensive monitoring and assessment of laboratory performance, and ensures that all data produced by ARI will be of the highest possible quality.

# Section 14: APPENDICES

**A. Laboratory Organization and Key Personnel Resumes**
**B. Training and Demonstration of Proficiency**
**C. Laboratory Facilities**
**D. Laboratory Instrumentation**
**E. Standard Operating Procedures**
**F. Sample Collection Containers and Preservatives**
**G. Laboratory Workflow**
**H. Analytical Methods**
**I. Method Detection Limits and Reporting Limits**
**J. Tuning and Calibration Criteria, Volatile and Semi-volatile Organics**
**K. Quality Control Recovery Limits**
**L. Internal Audit Schedule**
**M. Laboratory Certification and Accreditation**
**N. Data Reporting Qualifiers**
**O. Personal Conduct Statement**
**P. QA Policies**
**Q. Modification to ARI's LQAP**

# Appendix A

# Laboratory Organization Chart
# and
# Key Personnel Resumes

# KEY PERSONNEL RESUMES

## Mark Weidner

Laboratory Director

Profile

Mr. Weidner co-founded Analytical Resources, Inc., along with Brian Bebee, Sue Dunnihoo and David Mitchell. Prior to his co-founding of ARI in 1985, Mr. Weidner was the Head Mass Spectroscopist at Michigan State University and an instructor at the Finnigan Institute. As Laboratory Director, Mr. Weidner is responsible for overall laboratory performance, as well as facility expansion and major purchasing. Mr. Weidner is intimately familiar with all operational and analytical aspects of ARI and initiated many of the procedures currently in use.

Education:

M.S., Medicinal Chemistry, Purdue University, W. Lafayette, IN (1978).

B.S., Biochemistry, Michigan State University, E. Lansing, MI (1975).

Experience:

Laboratory Director/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to present).

Senior Chemist, City of Seattle, Seattle, WA (1981 to 1985).

Instructor, Finnigan Institute, Cincinnati, OH (1979 to 1981).

Mass Spectroscopist, Michigan State University (1978 to 1979).

**Brian Bebee**

Laboratory Manager

Administrative Services Manager

Profile:

Mr. Bebee co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and David Mitchell. Prior to his co-founding of ARI, Mr. Bebee had gained extensive GC/MS experience as a GC/MS Chemist at the Municipality of Metropolitan Seattle, (METRO). When he co-founded ARI in 1985, Mr. Bebee became the Organics Division Manager until 1993, when he assumed the position of Laboratory Manager. As Laboratory Manager, Mr. Bebee is responsible for the day to day flow of all laboratory operations, including personnel, instrument, and procedural concerns. He is also responsible for the direct supervision of the Volatile and Semivolatile Laboratories.

Education:

A.A., Oceanography, Marine Biology, Biology, Shoreline Community College (1973).

Experience:

Laboratory Manager, Analytical Resources, Inc., Seattle, WA (1987 to present).

Organics Division Manager/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to 1987).

GC/MS/DS Operator, Municipality of Metropolitan Seattle, Seattle, WA (1980 to 1985).

Senior Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1976 to 1980).

Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1973 to 1976)

## David Mitchell

Quality Assurance Program Manager

Profile:

Mr. Mitchell co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and Brian Bebee. Prior to his co-founding of ARI, Mr. Mitchell had gained extensive experience in the environmental chemistry field as Senior Chemist and Trace Organics Laboratory Supervisor at the Municipality of Metropolitan Seattle (METRO). His responsibilities include the management of ARI's Quality Assurance/Quality Control Program.

Education:

Graduate Work in Chemistry (Organic/Biological), University of Wyoming, Laramie, WY (1970 to 1974).

B.S., Chemistry, Upper Iowa College, Fayette, IA (1970).

Experience:

Quality Assurance Manager, Analytical Resources Inc., Seattle, WA (1998 to Present)
Client Services Manager, Analytical resources Inc., Seattle WA (1987 to 1998)
Vice President/Co-founder of Analytical Resources, Inc., Seattle, WA (1985 to 1987).
Senior Chemist, METRO Trace Organics Laboratory, Seattle, WA (1979 to 1985).
Research Associate, Northwestern University Medical School (1974 to 1979).

## Susan Dunnihoo

Computer Services Manager
Administrative Services Manager

Profile:

Ms. Dunnihoo co-founded Analytical Resources, Inc., along with Mark Weidner, Brian Bebee, and David Mitchell. Prior to her co-founding of ARI, Ms. Dunnihoo had gained extensive experience in the environmental chemistry field through her work at Laucks Testing Laboratories, the City of Tacoma, and the Municipality of Metropolitan Seattle (METRO). As Computer Services Manager, Ms. Dunnihoo is responsible for the supervision of the Computer Services Section. She is also responsible for LIMS administration, which includes testing the LIMS for data integrity, as well as ensuring that client deliverable requirements are met.

Education

Graduate work in Chemistry, University of Washington.

B.A., Chemistry, Augsburg College, Minneapolis, MN (1976)

Experience

Computer Services Manager/Secretary, Analytical Resources, Inc., Seattle, WA (1985 to present)

Chemist, Laucks Testing Laboratories, Seattle, WA (1983 to 1985)

Chemist, City of Tacoma, Plant II, Tacoma, WA (1982 to 1983)

GC/MS/DS Operator, METRO TPSS Lab, Seattle, WA (1980 to 1982)

## Jay Kuhn

Inorganic Division Manager

Profile:

Mr. Kuhn oversees ARI's Inorganic Division, which includes the Metals Sample Preparation, Metals Analysis, and Conventional Wet Chemistry sections. He has extensive experience in the environmental chemistry field, with an emphasis in inorganic analyses. Mr. Kuhn is experienced with in-house and EPA standard methods and protocols, as well as the operation, maintenance, and repair of ICP-MS, ICAP, CVAA, and Graphite Furnace instruments.

Education

Graduate work in Environmental Chemistry, University of Washington, Seattle, WA.

B.S. Chemistry, University of California at Santa Barbara (1980)

Experience

Inorganic Division Manager, Analytical Resources, Inc., Seattle, WA (1992 to present)

Metals Division Manager, Analytical Resources, Inc., Seattle, WA (1990 to 1992)

Research Technologist III and Laboratory Manager, UW College of Forest Resources Chemical Analysis Cost Center (1985-1990)

Research Technologist, UW College of Forest Resources Chemical Analysis Cost Center (1981 to 1985)

# Appendix B

# Training

Qualification Requirements

In addition to on-the-job training, ARI recommends a specific level of education and experience for the following positions:

*GC/MS Laboratory Supervisor*

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC/MS systems and one year supervisory experience.

*GC Laboratory Supervisor*

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC systems and one year supervisory experience.

*Sample Preparation Laboratory Supervisor*

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience in organic sample preparation and one year supervisory experience.

*Data Systems/LIMS Manager*

A Bachelor's degree with four or more computer-related courses and three years experience in systems management or programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

*Programmer Analyst*

A Bachelor's degree with four or more computer-related courses and two years experience in systems or application programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

*Quality Assurance Officer*

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

*Project Manager*

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

*GC/MS Chemist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC/MS system. Three years of GC/MS operations and spectral interpretation experience may be substituted in lieu of educational requirements.

*Mass Spectral Interpretation Specialist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and participation in training course(s) in mass spectral interpretation. Also, at least two years of experience in mass spectral interpretation is recommended.

*Purge and Trap Expert*

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year experience operating a purge and trap type liquid concentrator interfaced to a GC/MS system.

*GC Chemist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and maintenance experience may be substituted in lieu of educational requirements.

*Pesticide Analysis Expert*

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and spectral interpretation experience may be substituted in lieu of educational requirements.

*ICP Spectroscopist*

A Bachelor's degree in chemistry or a scientific/engineering discipline and Four years of applied experience with ICP analysis of environmental samples. Four years of ICP experience may be substituted in lieu of educational requirements.

*ICP Operator*

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining ICP instrumentation. Three years of ICP experience may be substituted in lieu of educational requirements.

*Atomic Absorption (AA) Operator*

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining graphite furnace and cold vapor AA instrumentation. Three years of AA experience may be substituted in lieu of educational requirements.

*Conventionals (Classical Chemistry) Analyst*

A Bachelor's degree in chemistry of a scientific/engineering discipline and one year of experience with classical chemistry procedures. Three years of classical chemistry experience may be substituted in lieu of educational requirements.

*Sample Preparation Expert*

A high school diploma and one college level course in chemistry. One year of experience in sample preparation is also recommended.

# Appendix C

# Laboratory Facilities

ANALYTICAL RESOURCES INC. occupies a total of 23,500 square feet of floor space located at 4611 S. 134th Place in Tukwila, Washington. The laboratory facility, constructed between September 2001 and June 2002, includes:

- State-of-the-art heating, ventilation and air conditioning (HVAC) systems to assure a clean comfortable working environment while maintaining air flow balance designed to minimize the possibility of sample cross contamination between laboratory areas.
- A central service area provides space for three walk-in coolers (356 sq. ft. total), two walk-in freezers (760 cubic ft.), eight reach-in freezers, and sample cooler storage.
- A data network linking all workstations to a centralized server room. All connections are made to managed switches and hubs and are protected by the latest firewall technology and uninterruptible power supplies.
- Distribution systems to deliver pressurized Air, Zero Grade Air, Argon, Helium, Hydrogen, Nitrogen and Argon/Hydrogen to the laboratory areas from a central location.
- A system to deliver ASTM Type 1 water directly to sinks in each laboratory area. Water is purified by filtration, ion exchange and reverse osmosis and continuously re-circulated through a filtration + ion exchange + UV radiation polishing loop that delivers water directly to the laboratories.
- An isolated and ventilated hazardous waste storage area.
- An electronic repair shop and storage room.
- Alarm monitored fire sprinkler and intrusion detection systems

The facilities are divided into five functionally-distinct sections as detailed below:

1) The Organics Division features three main laboratory areas as described below:
   - The Organics Extraction Laboratory (2400 sq. ft.) is utilized to isolate and concentrate organic compounds from various environmental sample matrices. The laboratory contains approximately 200 linear feet of bench space and nine fume hoods. It is equipped with two gel permeation chromatographs, an accelerated solvent extractor (ASE) and a gas chromatograph for extract screening purposes. The laboratory includes a separate area for extraction of aqueous samples, a glassware cleaning area and individual workstations for the laboratory supervisor and analyst.
   - The Semivolatile Organics Analysis Laboratory (3000 sq. ft) has 124 linear feet of instrument bench space plus personal workstations. The Laboratory is equipped with seven Gas Chromatographs (GCs) with six GC-MS instruments, one High Performance Liquid Chromatograph (HPLC) and a fume hood for preparation of standard solutions and dilution of samples. Each gas chromatograph is individually vented to the outside for removal of heat and potentially contaminated GC exhaust gases.
   - The Volatile Organics Analysis (VOA) Laboratory (2500 sq. ft) houses seven GC-MS and two GC-PID instruments dedicated to volatile organics analysis. Each instrument is vented to the outside. The laboratory area includes two fume hoods, a sample/standards preparation area, a TCLP preparation/tumbler room and sample holding refrigerators. The HVAC system maintains a positive air pressure in the laboratory using filtered air from outside of the building. This eliminates the possibility of cross contamination of samples with solvents from other areas of the laboratory.

2) The Inorganic Division includes a Trace Metals Laboratory and the Conventional Analyses Laboratory:

- Trace Metals Laboratory (3000 square feet)
    - The Metals Preparation Laboratory (1200 sq. ft) contains five fume hoods including two 8-foot polypropylene. An additional eight foot polypropylene laminar flow fume hood is housed in a separate class 1000 clean room. The lab is equipped with tumblers, hot-plates, digestion blocks, facilities for glassware cleaning, and a spectrophotometer for cold vapor analysis of mercury, a TCLP tumbler room, and storage areas.
    - The Metals Instrument Laboratory (1300 sq. ft) features two atomic absorption spectrometers for graphite furnace analyses, two inductively coupled argon plasma spectrometers (ICP) for simultaneous analysis of metals species, and an ICP-mass spectrometer for analysis of metals species at low detection levels.
    - A 500 sq. ft. Office provides desk area for Trace Metals laboratory personnel.
- The Conventional Analyses (Wet Chemistry) Laboratory (2500 sq. ft.) contains approximately 200 linear feet of bench space, eight fume hoods and includes a separate microbiology room. Instruments in this lab include two Rapid-Flow Analyzers, two TOC analyzers, an ion chromatograph, two uv/visible spectrophotometers, and various other equipment necessary for the evaluation of inorganic parameters.

3) The Geotechnical Laboratory includes 2500 square feet of space with special areas and equipment for soil testing, treatability studies, and soil/sediment leaching studies. The Laboratory includes approximately 50 feet of linear bench space and 5 fume hoods.

4) The Sample Receiving Facility consists of an area to accept and log-in samples to ARI's Laboratory Information Management System (LIMS) and an area to prepare and ship sampling supplies.
- The Sample Receiving Facility (1000 sq. ft.) is equipped with two fume hoods, and 70 feet of bench space. Four computer terminals are available to log samples into ARI's LIMS.
- The Sampling Containers Facility (500 sq. ft.) is used to prepare sampling containers for shipment to ARI's client designated locations.

4) Administrative Areas (8600 sq. ft.) include:
- The Quality Assurance Section
- Executive Offices
- Project Management Section
- The Human Resources Section
- The Computer Services Section
- Two Conference Rooms
- A Lunch Room
- Several Storage Areas

# Appendix D

# Instrumentation and Computers

# INSTRUMENTATION and COMPUTER SYSTEMS

## Organic Extractions Equipment

**(ASE 1) Accelerated Solvent Extractor (1998) –** Dionex ASE 200

**(GPC 1) Gel Permeation Chromatograph (1985) –** Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

**(GPC 2) Gel Permeation Chromatograph (2003) –** Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

## Gas Chromatograph - Mass Spectrometers (GC/MS)

**(FINN I) Finnigan MAT Incos 50 (1993) –** A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 5890 GC, a Tekmar LSC 2000 Purge and Trap and a Delta Perspective PTA-30 autosampler for VOA analysis of either aqueous or solid samples.

**(FINN III) Finnigan MAT Incos 50 (1987) -** A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes a Varian 3400 GC, a Tekmar LSC 2000 Purge & Trap and a Delta perspective PTA-30 autosampler for VOA analysis of aqueous samples.

**(FINN V) Finnigan MAT Incos 50 (1989) -** A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 5890 GC, a Tekmar LSC 2000 Purge & Trap and a Delta Perspective PTA-30 autosampler for VOA analysis of either aqueous or solid samples.

**(NT I) Hewlett Packard (1994)** - A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes a Hewlett Packard 5890 Series II Plus GC, an HP 5972A MSD and a HP 7673 autosampler.

**(NT 2) Hewlett Packard (1999)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 6890 GC, an HP 5973 MSD, an HP 7683 autosampler and an APEX Prosep 800 large volume injector.

**(NT3) Hewlett Packard (1999)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 6890 Plus GC, an HP 5973 MSD, a Tekmar LSC 2000 Purge/Trap and a Dynatech Precision Sampling PTA 30 autosampler for VOA analysis of aqueous or solid samples.

## Gas Chromatograph - Mass Spectrometers (GC/MS) (continued)

**(NT4) Hewlett Packard (2001)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an HP 6890-Plus GC, an HP 5973 MSD, an HP 6890 autosampler and an APEX Prosep 800 large volume injector.

**(NT5) Hewlett Packard (2002)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Tekmar LCS 2000 Purge and Trap and a Dynatech PTA 30 autosampler for VOA analysis of aqueous or solid samples.

**(NT6) Hewlett Packard (2002)** – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an HP 6890 Plus GC, an HP 5973 MSD and an HP 7683 autosampler.

## Gas Chromatographs

**Hewlett Packard 5890 Series II (2003) –** A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and integrator. Used for screening samples before full extraction.

**(ECD 1) Hewlett Packard 5890 (1986) -** A GC system equipped with dual ECD detectors, two capillary injectors, a HP 7673A autosampler and ChromPerfect data system.

**(ECD 2) Hewlett Packard 5890 Series II (2003) –** A GC system equipped with dual ECD detectors, two Cool on column capillary injectors, an HP7673A autosampler and ChromPerfect data system.

**(ECD 3) Hewlett Packard 5890 Series II (1991)** – A GC system equipped with Dual ECD detectors, two Cool on column capillary injectors, an HP7673 autosampler and ChromPerfect data system.

**(ECD 4) Hewlett Packard 5890 Series II (1994)** – A GC system equipped with dual ECD detectors, a split/splitless capillary injector, HP7673 autosampler and ChromPerfect data system.

**(FID 2) Hewlett Packard 5890 (1987)** – A GC system equipped with an FID detector, acapillary injector, an HP 7673A autosampler and ChromPerfect data system.

**(FID 3 A, B) Hewlett Packard 6890 (1996)** – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP Chemstation data system. A Restek GC Racer has been added to enhanced performance.

**(FID 4 A, B) Hewlett Packard 6890 (1996)** – A GC system equipped with dual FID detectors, two capillary injectors, a single tower HP 6890 autosampler, and HP Chemstation data system. A Restek GC Racer has been added to enhanced performance.

**(PID 1) Hewlett Packard 5890 (1988) –** A GC system equipped FID and PID detectors in series, an Dynatech PT30 autosampler and Tekmar LCS 2000 Sample Concentrator with ChromPerfect data system.

**(PID 2) Hewlett Packard 5890 – (1991)** –A GC system equipped with dual PID detectors, one in series with an FID, a Dynatech PT30 autosampler, an OI Analytical 4560 sample concentrator and a ChromPerfect data system.

**(ECD 5) Hewlett Packard 6890 Plus Micro – (2002)** – A GC system equipped with dual ECD detectors, two capillary column injectors, a dual tower HP 7683 autosampler, an APEX Prosep 800 large volume injector and an HP Chemstation data system.

**(FID 5) Hewlett Packard 5890 Series II (2005)** – A GC system equipped with FID and TCD detectors, an HP 7694 Headspace Sampler and HP Chem Station data aquisition system.

## Inorganic Instrumentation

**Perkin-Elmer SCIEX ELAN 6000 ICP-MS (1996)** - A completely automated ICP-Mass Spectrometer with autosampler and multitasking software. Computer controlled using ELAN NT Windows based software.

**Perkin-Elmer Optima 4300 ICP (2001)** - A completely automated dual view simultaneous ICP with auto-sampler and multitasking software.

**Varian 300Z (1992)** - A single channel atomic absorption graphite furnace instrument equipped with Zeeman background correction, and an auto-sampler.

**Varian 300Z (1991)** - A single channel atomic absorption graphite furnace instrument with Zeeman background correction, equipped with an auto-sampler.

**CETAC M-6000A Mercury Analyzer (2000) –** A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler.

**Dionex Ion Chromatography DX 500 (1997)** - Fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Peaknet software.

**Thermo Genesys 10 (2003)** - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

**Milton Roy 401 (1991)** - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

## Inorganic Instrumentation (continued)

**Alpkem RFA/2 Autoanalyzer (1990)** – The system is automated and computer controlled using Alpkem Soft Pac data acquisition for nutrient analysis.

**Lachat QuickChem 8000 Flow Injection Analyzer (2003)** – Automated flow injection instrument dedicated to low level nutrient analysis

**Dohrmann Apollo 9000 (2001)** - Total Organic Carbon (TOC) Analyzer. Includes an autosampler for water analysis

**Dohrmann DC190 TOC Analyzer with Boat Sampler (1994)** – Combustion/IR system dedicated to soil and sediment TOC analysis.

**Kontes Midi-Vap Cyanide Distillation Systems (1995)** – Each of the two systems is capable of simultaneously distilling up to 10 samples for cyanide analysis using small sample aliquots.

**Centrifuge (1987) -** Beckman Model GP with swinging bucket rotor and inserts for 250 ml bottles and scintillation vials

**Labconco 25 Place Block Digestion Unit.**

**Environmental Express Hot Block digestion blocks (8 ea) (1999-2002)** for digestion of samples prior to trace metals analysis.

**Hach COD Digestion Blocks (2)**

**Hach Ratio Nephelometer**

**Incubators: Lab-Line Ambi Hi-Lo Chamber** and **Thermolyne 41900.**

## GeoTech Laboratory Equipment

**Trautwein Soil Equipment 12 position flexible wall permeability station,**

**Soil Test Load frame, with 500, 2,000 and 10,000 pound load cells for QU, UU, and CU triaxial tests, with pore pressure.**

**Consolidation apparatus, 16 tsf**

**Geocon direct shear apparatus**

**Biosciences BI-1000, 8 position electrolytic respirometer**

**Microtox photo-luminescence toxicity tester**

**Beckman JP-21 refrigerated centrifuge with 6 x 500 ml fixed angle head**

**IEC DRP-6000 refrigerated centrifuge with a 4 x 1,000 ml swinging bucket head**

**Plas-Labs anaerobic test chambers**

**U.S. Army Corps of Engineers column settling; column and batch leaching apparatus**

## Network Servers

ARI's central laboratory computer is a Dell PC Server running the Windows NT platform. This system is home to ARI's Laboratory Information Management System (LIMS) database developed by Northwest Analytical of Portland, OR. The LIMS receives electronic data from all lab sections and produces hardcopy and electronic deliverables. In addition, the LIMS stores sample demographic data while providing a common tracking mechanism for all laboratory information.

The LIMS is connected to two sub-networks. Data is transferred electronically from the instrument data systems to the LIMS database. This key process enhances data integrity by reducing manual entry and manipulation of instrument output.

The metals section uses an Intel PC Server with the Windows 2000 Server operating system. This system runs as a file server for dBASE IV and MS Access 97 database applications. Once data is collected by the metals instrument computers, dBASE is used to process the data and transfer it to the LIMS database. The MS Access software has been customized by ARI's metals data supervisor to generate metals CLP forms and other internal reports.

The organics section uses an HP Unix Server with HP-UX 10.20 operating system. This system runs Target 3.4 data analysis software. All GC/MS and other GC instruments are networked to this system. In addition to providing one common platform for organics data processing, the Target software produces CLP forms for organics data packages.

The conventional analysis laboratory uses PC Workstations with MS Excel for data reduction. Data is manually entered into the LIMS systems using customized work lists.

Instrument data systems have been optimized with the latest software enhancements to reduce data processing time. Advances in processing have allowed ARI to meet the increasingly shorter turnaround requirements of our clients.

**Note: Extensive in-house replacement parts are available for lab instruments and computers, including spare circuit boards. A majority of all service maintenance is performed by ARI employees.**

# Appendix E

# ARI Active SOPs

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| | | **Sample Receiving / Project Management** | | |
| 001S | CSSR | Sample Receiving | 019 | 7/13/05 |
| 003S | CSSR | Project Tracking | 006 | 10/23/04 |
| 004S | CSPM | Data Storage, Archival and Retrieval | 007 | 2/20/06 |
| 005S | CSPM | Project Management | 004 | 10/30/04 |
| 056S | CSPM | Handling of USDA Regulated Soil | 001 | 10/12/05 |
| | | **Computer Services** | | |
| 101S | CO | Software Quality Assurance (Draft) | 003 | 2/25/04 |
| | | **Data Reporting** | | |
| 201S | DS | GC-Data Reporting and Review | 006 | 10/25/04 |
| 202S | DS | GC-MS Data Reporting and Review | 004 | 10/25/04 |
| 203S | DS | Volatile Organics Data Reporting and Review | 004 | 10/26/04 |
| 204S | DS | GC BETX Data Reporting and Review | 004 | 10/26/04 |
| 205S | DS | Conventionals Data Review and Reporting | 003 | 2/20/06 |
| | | **Organic Extractions** | | |
| 300S | E | Sonicator Function Testing | 007 | 10/14/05 |
| 301S | E | Organics Glassware Preparation | 008 | 10/29/04 |
| 302S | E | Silica Gel Clean-up for Pesticides and PCB | 002 | 4/24/06 |
| 303S | E | Tissue Extraction – Pesticide/PCB | 001 | 8/4/05 |
| 304S | E | Soil Extraction – NWTPH-D, AK102, AK103 MicroTip Sonication | 012 | 9/23/05 |
| 305S | E | BAN Extraction – Water – Separatory Funnel | 013 | 11/01/04 |
| 306S | E | Gel Permeation Chromatography | 003 | 10/28/04 |
| 308S | E | Water Extraction – NWTPH-D, AK102, AK103 | 013 | 5/17/05 |
| 311S | E | Pesticide/PCB Extraction – Water – Sep Funnel | 016 | 2/9/05 |
| 315S | E | Butyl Tin Extraction – Soil/Sediment – Sonication | 008 | 10/28/04 |
| 316S | E | Butyl Tin Extraction – Pore Water – Separatory Funnel | 011 | 3/8/03 |
| 320S | E | Butyl Tin Species – Sediment – *in-situ* Ethylation | 001 | 5/14/04 |
| 324S | E | Herbicide Extraction – Water – Separatory Funnel | 011 | 9/17/03 |
| 325S | E | Herbicides Extraction – Soil – Macro-tip | 009 | 10/10/05 |
| 326S | E | Extraction of Water for Organophosphorus Pesticides | 007 | 8/27/00 |
| 327S | E | Extraction of Soil for Organophosphorus Pesticides | 006 | 10/18/99 |
| 328S | E | Chlorinated Phenols – Water – Separatory Funnel | 011 | 10/25/04 |
| 332S | E | PCB Extraction – Wipe Samples | 008 | 3/8/03 |
| 333S | E | PCB Extraction – Soil - Medium Level | 009 | 6/6/05 |
| 334S | E | Sulfur Removal from Sample Extracts | 006 | 2/9/05 |
| 335S | E | Sulfuric Acid Clean-up of Sample Extracts | 009 | 2/9/05 |
| 336S | E | Low Level Manchester Extraction for Pesticides and PCBs | 014 | 1/31/05 |
| 340S | E | BAN Extraction – Tissue – Tissuemizer | 009 | 7/28/05 |
| 341S | E | SIM-PNA Extraction – Water – Liquid Liquid | 003 | 9/17/03 |

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| 342S | E | Extraction of Soil Samples for NWTPH-HCID | 009 | 3/9/05 |
| 344S | E | BAN Extraction – Water – Liquid-Liquid | 011 | 8/15/05 |
| 349S | E | Paint Filter Liquids Test | 006 | 10/26/04 |
| 350S | E | Pest/PCB Extraction – PSEP/PSDDA – Macro-tip | 009 | 2/12/04 |
| 355S | E | SIM-PNA Extraction – Water – Separatory Funnel | 003 | 9/17/03 |
| 357S | E | PNA Extraction – Soil – Micro-tip | 002 | 10/28/04 |
| 359S | E | Sample Screening for PCB/ABN/PNA/PNA-SIM | 006 | 10/27/04 |
| 360S | E | Extractions Opening/Closing Checklist | 005 | 10/28/04 |
| 367S | E | Chlorinated Phenols – Soil – Micro-tip | 003 | 5/2/05 |
| 374S | E | BAN Extraction – PSEP/PSDDA – Macro-tip | 003 | 7/29/03 |
| 377S | E | BAN Extraction – Soil – Micro-tip | 003 | 10/28/04 |
| 381S | E | Soil Extraction – NWTPH-D, AK102, AK103 – ASE | 003 | 11/6/02 |
| 398S | E | EPH Extraction/Fractionation – Soil – Micro-tip | 003 | 9/30/04 |
| 399S | E | EPH Extraction/Fractionation – Water | 004 | 10/15/04 |
| | | **Gas Chromatography** | | |
| 400S | GC | GC Analysis and General Operations | 009 | 7/20/05 |
| 403S | GC | PCB Analysis – EPA Method 8082 | 015 | 9/25/05 |
| 404S | GC | Gasoline Analysis of Soil & Water (NWTPH-G) | 010 | 10/9/04 |
| 405S | GC | Herbicides Analysis – EPA Method 8151 | 008 | 10/15/04 |
| 407S | GC | Diesel Hydrocarbon Analysis (NWTPH-D) | 009 | 5/10/05 |
| 409S | GC | Hydrocarbon Identification (NWTPH-HCID) | 006 | 12/14/05 |
| 410S | GC | BTEX Analysis by GC-PID – EPA Method 8021 | 009 | 10/6/04 |
| 412S | GC | Chlorinated Phenols – EPA Method 8040 | 003 | 10/30/03 |
| 421S | GC | Diesel & Residual Range Organics (AK102-103) | 005 | 10/6/03 |
| 422S | GC | Gasoline Range Organics (AK101) | 004 | 10/15/04 |
| 423S | GC | Pesticides Analysis – EPA Method 8081 | 010 | 9/23/05 |
| 425S | GC | PCB – Congener Analysis – GC-ECD | 001 | 12/27/97 |
| 426S | GC | Glycol Analysis using GC-FID | 004 | 9/10/03 |
| 427S | GC | Water Soluble SVOA via Direct Aqueous Injection | 002 | 6/30/05 |
| 428S | GC | Extractable Petroleum Hydrocarbon | 003 | 7/25/04 |
| 430S | GC | Volatile Petroleum Hydrocarbons | 003 | 10/14/04 |
| | | **Metals Sample Preparation and Analyses** | | |
| 500S | MP | Metals Glassware Prep. | 003 | 10/18/04 |
| 502S | MI | Varian 300Z Graphite Furnace Analysis | 008 | 10/22/04 |
| 505S | MP | Metals Sample Prep. Method 3020A (TWN) | 008 | 9/22/04 |
| 506S | MP | Metals Sample Prep. Methods 7060A/7740 (RMA) | 008 | 9/27/04 |
| 507S | MP | Metals Sample Prep. Method 3050B (SWC) | 008 | 11/3/04 |
| 508S | MP | Metals Sample Prep. Method 3005A (RWC) | 008 | 10/5/04 |
| 509S | MP | Metals Sample Prep. Method 3050B (SWN) | 008 | 11/3/04 |
| 510S | MP | Metals Sample Prep. Method 3010A (TWC) | 008 | 10/5/04 |
| 511S | MP | Metals Sample Prep. Method 7471 (SMM) | 006 | 11/3/04 |
| 514S | MP | Metals Sample Prep. Filter/Wipe (PHN,PNM) | 001 | 11/3/04 |
| 522S | MP | Metals Sample Prep. CLP Method 3005-M (RCN) | 007 | 11/3/04 |
| 525S | MP | Metals Sample Prep. CLP Method 3005-M (RCC) | 007 | 11/3/04 |

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| 526S | MI | Metals Standards Prep. And Maintenance | 006 | 10/20/04 |
| 527S | MI | Metals Spiking | 008 | 10/20/04 |
| 529S | MP | Percent Solids Determination | 004 | 11/3/04 |
| 531S | MP | TCLP Extraction: Method 1311 | 008 | 1/11/06 |
| 532S | MP | Metals Sample Prep. Method 7471A (SWM) | 004 | 11/4/04 |
| 533S | MP | Metals Sample Prep. Method 7470A (TWM) | 005 | 10/5/04 |
| 535S | MP | Metals Sample Prep. Method 200.8 (REC) | 002 | 11/4/04 |
| 536S | MP | Metals Sample Prep. Method 200.8 (REN) | 003 | 10/5/04 |
| 537S | MP | Metals Sample Prep. Method 200.8 (RHN) | 003 | 10/20/04 |
| 538S | MI | Elan 6000 ICP-MS | 005 | 2/5/04 |
| 539S | MI | Cetac Mercury Cold Vapor Analysis | 002 | 10/20/04 |
| 540S | MI | ICP Analysis | 004 | 10/20/04 |
| | | **Wet Chemistry (Conventional) Analyses** | | |
| 600S | CV | Ferrous Iron | 003 | 10/26/04 |
| 601S | CV | Cyanide | 008 | 11/2/04 |
| 602S | CV | TOC – Soil and Sediment | 008 | 3/1/03 |
| 603S | CV | Acidity | 002 | 11/2/04 |
| 604S | CV | Alkalinity | 003 | 3/18/04 |
| 605S | CV | Biochemical Oxygen demand | 004 | 1/9/06 |
| 606S | CV | Bromide | 002 | 11/2/04 |
| 607S | CV | Cation Exchange Capacity | 003 | 11/2/04 |
| 608S | CV | Chlorophyll a | 003 | 11/2/04 |
| 609S | CV | Chemical Oxygen Demand | 002 | 11/2/04 |
| 610S | CV | Color (Visual Comparison) | 003 | 11/2/04 |
| 611S | CV | Conductivity | 003 | 11/2/04 |
| 612S | CV | Chloride (Automated) | 003 | 11/2/04 |
| 614S | CV | Hexavalent Chromium | 004 | 11/2/04 |
| 615S | CV | Ammonia (Automated) | 005 | 4/21/04 |
| 616S | CV | Ammonia (ISE) | 003 | 2/12/04 |
| 617S | CV | Nitrate & Nitrite+Nitrate | 004 | 11/2/04 |
| 618S | CV | pH | 005 | 2/23/06 |
| 620S | CV | Standards Preparation | 003 | 11/2/04 |
| 621S | CV | Ion Chromatography | 005 | 9/24/03 |
| 623S | CV | Fluoride | 003 | 04/19/04 |
| 628S | CV | Microbiology (Coliform) | 002 | 11/2/04 |
| 631S | CV | Phosphorus | 003 | 10/3/03 |
| 632S | CV | Dissolved Oxygen | 003 | 7/14/05 |
| 633S | CV | Phenol | 004 | 10/27/04 |
| 634S | CV | Oxidation/Reduction Potential | 003 | 11/2/04 |
| 635S | CV | Salinity | 002 | 11/2/04 |
| 637S | CV | Sulfate (Automated) | 006 | 11/2/04 |
| 639S | CV | Solids | 005 | 11/2/04 |
| 640S | CV | Sulfide | 002 | 7/14/05 |
| 641S | CV | Sulfite | 002 | 11/2/04 |

| SOP # | Section | | Version | Date |
|---|---|---|---|---|
| 642S | CV | Total Kjeldahl Nitrogen | 002 | 7/14/05 |
| 643S | CV | Turbidity | 002 | 11/2/04 |
| 645S | CV | Glassware Cleaning | 002 | 11/2/04 |
| 648S | CV | Hexane Extractable Materials - EPA Method 1664 | 000 | 11/2/04 |
| 649S | CV | TOC-Aqueous | 001 | 11/2/04 |
| | | **Volatile Organic Analyses** | | |
| 700S | VOA | Volatile Organics Analysis – GC/MS | 009 | 7/11/05 |
| 702S | VOA | GC/MS Volatiles – Autosampler Operation | 004 | 11/1/04 |
| 703S | VOA | Volatile Organic Compounds by GC/MS SIM | (Draft) | |
| 704S | VOA | Volatile Organic Standard Preparation | 003 | 11/1/04 |
| 706S | VOA | Volatile Organic Analysis – EPA Method 524.2 | 005 | 2/23/04 |
| 707S | VOA | TCLP/ZHE Extraction for VOA | 001 | 11/01/04 |
| | | **Semi-Volatile Organic Analyses** | | |
| 801S | SVOA | PNA by GC/MS SIM | 006 | 3/14/03 |
| 802S | SVOA | Butyl Tin Species (GC-MS-SIM) | 009 | 5/17/04 |
| 803S | SVOA | Butyl Tin Species in Porewater (GC-MS-SIM) | 007 | 1/10/01 |
| 804S | SVOA | Semivolatile Organics by GC/MS (8270D) | 010 | 7/5/05 |
| | | **Quality Assurance Procedures** | | |
| 1000S | QA | TCLP Extractor RPM Monitoring | 004 | 7/29/05 |
| 1001S | QA | Refrigerator and Freezer Temperature Monitoring | 010 | 8/17/05 |
| 1002S | QA | Laboratory Ethics | 000 | 3/25/05 |
| 1003S | QA | Balance Monitoring | 009 | 10/18/04 |
| 1004S | QA | Document Control – Lab. Forms and Logbooks | 007 | 10/19/04 |
| 1005S | QA | Quality Assessment and Improvement | 009 | 4/5/06 |
| 1006S | QA | Document Control–Standard Operating Procedures | 005 | 9/16/05 |
| 1007S | QA | Internal Chain of Custody-Conventionals | 005 | 10/23/04 |
| 1008S | QA | Internal Chain of Custody-Metals | 005 | 10/18/04 |
| 1009S | QA | Internal Chain of Custody-SVOA | 008 | 9/15/05 |
| 1010S | QA | Internal Chain of Custody-Volatiles | 006 | 10/28/04 |
| 1012S | QA | Standard Preparation – GC and Semivolatiles | 003 | 10/22/04 |
| 1013S | QA | Chemical Receiving and Reagent Preparation | 005 | 5/23/05 |
| 1015S | QA | Pipette Verification | 002 | 10/18/04 |
| 1016S | QA | Control Limits and Control Charts | 003 | 10/19/05 |
| 1017S | QA | Training and Demonstration of Proficiency | 006 | 9/13/05 |
| 1018S | QA | Determination of MDLs and RLs | 005 | 09/11/03 |
| 1019S | QA | Chain of Custody, Archival & Disposal-Org. Ext. | 003 | 10/20/04 |
| 1021S | QA | Manual Integration of Chromatographic Peaks | 000 | 10/29/04 |
| 1022S | QA | Volumetric Ware Verification | 001 | 10/15/04 |

# Appendix F

# Sample Containers, Preservation and Holding Times

# Summary of Sample Containers, Preservatives and Holding Time Requirements

| Parameter | Method Reference | Container Water | Container Soil/ Sed. | Preservation | Holding Time Water | Holding Time Soil |
|---|---|---|---|---|---|---|
| Acidity | 305.1/2310B | 500 mL HDPE | | | 14 Days | |
| Alkalinity | 310.1/2320B | 500 mL HDPE(1) | | | 14 Days | |
| Ammonia | 350.1/4500-NH3 | 500 mL HDPE | 4 oz. WMG | 2 mL (a) | 28 Days | 7 Days |
| Anions ($Cl^-$, $Br^-$, $F^-$, $NO_2^-$, $NO_3^-$, $SO_4^{-2}$, $PO_4^{-3}$) | 300.0/9056 | 500 mL HDPE | 4 oz. WMG | | 48 Hour | 7 Days |
| BETX | 8021/8260 | 2-40 mL vial(1) | 2oz.WMGS(1) | (b) | 14 Days<br>7 Days(2) | 14 Days |
| Biological Oxygen Demand (BOD) | 405.1/5210 | 1 Liter HDPE | | | 48 Hours | |
| Bromide | 300.0/9056<br>4500-Br B | 500 mL HDPE | | | 28 Days | |
| Butyl Tin Species | GC/MS (SIM) | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Cation Exchange Capacity | 9080/MSA 8 & 9 | | 4 oz. WMG | | | 6 Months |
| Chemical Oxygen Demand (COD) | 410.4/5220D | 250 mL AG | 4 oz. WMG | 1 mL (a) | 28 Days | 28 Days |
| Chloride | 325.2/325.3<br>300.0/9056<br>4500-CL | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Chlorophyll a | SM10200H | 1 Liter AHDPE | | | 24 Hours | |
| Coliform, Fecal | SM9222D | Corning 4 oz. | 4 oz. WMG | (d) | 24 Hours | 24 Hours |
| Coliform, Total | SM9222B/9132 | Corning 4 oz. | 4 oz. WMG | (d) | 24 Hours | 24 Hours |
| Color | 110.2/2120B | 500 mL HDPE | | | 48 Hours | |
| Conductivity | 120.1/9050A<br>2510B/MSA 10 | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Corrosivity | SM2330 | 500 mL HDPE | | | 7 Days | |
| Cyanide, Total | 335.2/9010B<br>4500-CN | 500 mL HDPE | 4 oz. WMG | 2 mL (c) | 14 Days | 14 Days |
| Cyanide, Amenable | 335.1/9010B<br>4500-CN G | 500 mL HDPE | 4 oz. WMG | | 48 Hours | 14 Days |
| Cyanide, Weak Acid Dissociable (WAD) | SM4500 CN I | 500 mL HDPE | 4 oz. WMG | 2 mL (c) | 14 Days<br>48 Hours(2) | 14 Days |
| Dissolved Oxygen | 360.2/4500-O C | BOD bottle | | fixed in field | 8 Hours | |
| HEM / HEM-SGT | 1664 / 9071 | 1 Liter AG | 4 oz. WMG | 5 mL (a) | 28 Days | 28 Days |
| FOG (Fats/Oils/Grease ) | 5520B/413.1 | 1 Liter AG | 4 oz. WMG | 5 mL (a) | 28 Days | 28 Days |
| Fecal Streptococci | SM9230C | Corning 4 oz. | 4 oz. WMG | (d) | 24 Hours | 24 Hours |
| Fluoride | 340.2/300.0<br>9214/9056<br>4500-F B | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Herbicides | 8151A | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Hardness (Calculation) | 6010/2340B | 500 mL HDPE | | 5 mL (f)(3) | 6 Months | |
| Hexavalent Chromium ($Cr^{+6}$) | 7196A<br>3500 CR-D | 500 mL HDPE | 4 oz. WMG | | 24 Hours | 28 Days |
| Iodide | 345.1 | 500 mL HDPE | | | On Receipt | |
| Iron, Ferrous ($Fe^{+2}$) | 3500FE D | 500 mL AG | | 2 mL (b) | On Receipt | |
| Metals | 6010/7000/<br>200.8 series | 500 mL HDPE | 4 oz. WMG | 5 mL (f)(3) | 6 Months | 6 Months |
| Mercury | 7470/7471 | 500 mL HDPE | 4 oz. WMG | 5 mL (f)(3) | 28 Days | 28 Days |
| Nitrate | 353.2/300.0<br>9056<br>4500-NO3 F | 500 mL HDPE | 4 oz. WMG | | 48 Hours | 7 Days |
| Nitrate + Nitrite | 353.2/300.0<br>9056<br>4500-NO3 F | 500 mL HDPE | 4 oz. WMG | 2 mL (a) | 28 Days<br>48 Hours (2) | 7 Days |

# Summary of Sample Containers, Preservatives and Holding Time Requirements

| Parameter | Method Reference | Container Water | Container Soil/ Sed. | Preservation | Holding Time Water | Holding Time Soil |
|---|---|---|---|---|---|---|
| Oil & Grease (See FOG) | | | | | | |
| Organophosphorous Pesticides | 8141 | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Pentachlorophenol | 8041-M/8270D | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Pesticides/PCBs | 8081A/8082 | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Petroleum Hydrocarbon-Diesel (TPH-D) (DRO) | NWTPH-Dx AK102 | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Petroleum Hydrocarbon-ID (HCID) | NWTPH-HCID 8015M | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Petroleum Hydrocarbons-Gas (TPH-G) (GRO) | NWTPH-G AK101 | 2 - 40 mL vial(1) | 2oz.WMGS(1) | (b) | 14 Days 7 Days(2) | 14 Days |
| pH | 150.1/9040B 9045C/4500-H+ | 500 mL HDPE | 4 oz. WMG | | 24 Hours | 14 Days |
| Phenols, GC/FID | 8041M | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Phenols, Total | 420.1/5530 | 500 mL HDPE | 4 oz. WMG | 2 ml (a) | 28 Days | 28 Days |
| Phosphorous, Total | 365.2 4500-P B | 500 mL HDPE | 4 oz. WMG | 2 ml (a) | 28 Days | 28 Days |
| Phosphorous, Ortho (Soluble Reactive Phosphorous – SRP) | 365.2/300.0 9056/4500-P E | 500 mL HDPE | 4 oz. WMG | | 48 Hours | 28 Days |
| Polynuclear Aromatic Hydrocarbon-PAH | 8270D & SIM | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Salinity | SM2520B | 500 mL HDPE | | | 28 Days | |
| Semivolatile Organics | 8270D | 2-500 mL AG | 8 oz. WMG | | 7 Days | 14 Days |
| Solids, Total (TS) | 160.3/2540 B | 1 Liter HDPE | 4 oz. WMG | | 7 Days | 14 Days(5) |
| Solids, Total Suspended (TSS) | 160.2/2540 D | 1 Liter HDPE | | | 7 Days | |
| Solids, Total Dissolved (TDS) | 160.1/2540 C | 1 Liter HDPE | | | 7 Days | |
| Solids, Total Volatile (TVS) | 160.4/2540 E | 1 Liter HDPE | 4 oz. WMG | | 7 Days | 7 Days |
| Solids, Settleable (SS) | 160.5/2540 F | 1 Liter HDPE | | | 48 Hours | |
| Solids, Volatile Suspended (TVSS) | SM2540E | 1 Liter HDPE | | | 7 Days | |
| Sulfate | 375.2/300.0 9036/9056 4500-SO4F | 500 mL HDPE | 4 oz. WMG | | 28 Days | 28 Days |
| Sulfide, Acid Volatile (AVS) | EPA 1991 | 500 mL HDPE(1) | | | | 14 Days |
| Sulfide | 376.2 4500S2 D 9030B | 500 mL HDPE(1) | 2 oz.WMGS(1) | 2 ml (e) + 1 mL (c) pH > 9.0 | 7 Days | 7 Days |
| Sulfite | 377.1 4500-SO3B | 500 mL HDPE | | | 24 Hours | |
| Total Kjeldahl Nitrogen (TKN) | 351.2/351.3 4500-NORG | 500 mL HDPE | 4 oz. WMG | 2 ml (a) | 28 Days | 28 Days |
| Total Organic Carbon (TOC) | 415.1/5310B 9060/Plumb(4) | 250 mL AG | 4 oz. WMG | 1 ml (a) | 28 Days | 28 Days |
| Turbidity | 180.1/2130 B | 500 mL HDPE | | | 48 Hours | |
| Volatile Organic Compounds | 524.2/624 8260/8260SIM | 3-40 mL vial(1) | 2 oz.WMGS(1) | (b) | 14 Days 7 Days(2) | 14 Days |

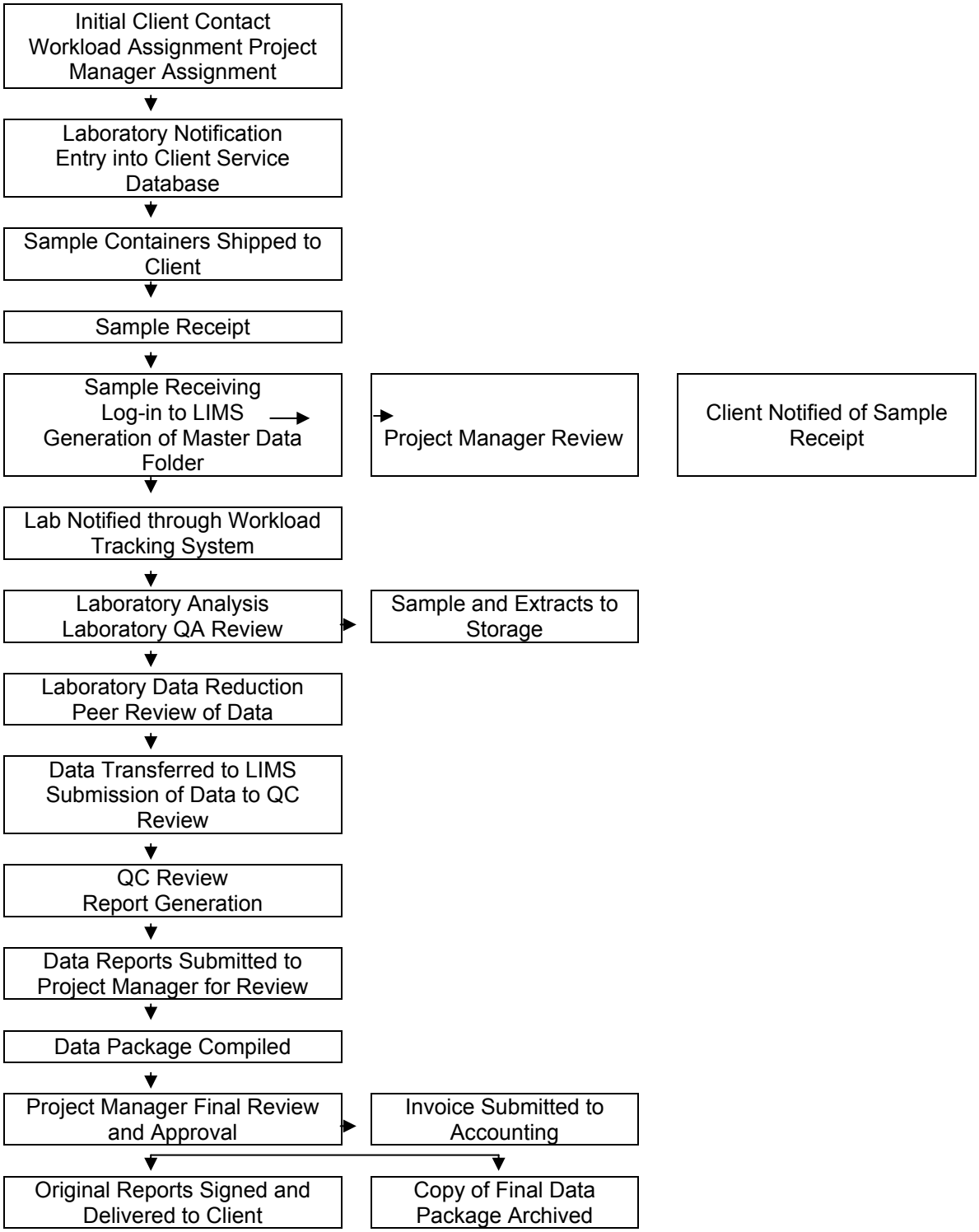
**Containers:**
AG = Amber Glass Boston Round Bottle
WMG = Wide Mouth Glass Jar
WMGS = Wide Mouth Glass Jar with Septa
HPDE = High Density Polypropylene
AHPDE = Amber HPDE

**Preservation:**
(a) = 9N $H_2SO_4$
HCl to pH<2.0
(c) = 10N NaOH
(d) = $Na_2S_2O_3$ (Sodium Bisulfite) Tablet
(e) = 2N ZnOAc
(f) = 1:1 $HNO_3$

**Notes:**
(1) = No Headspace
(2) = When Unpreserved
(3) = Total Metals or field filtered samples only
(4) = Plumb, R. H. Jr., *Procedures for Handling and Chemical Analysis of* (b) (b) = *Sediment & Water Samples*, May 1981, USACE Publication AD/A103788
(5) = When requested as a separate analyte. TS to correct for dry weight has the same holding time as the analytical parameter

# Appendix G

# Laboratory Workflow


Initial Client Contact
Workload Assignment Project Manager Assignment
Laboratory Notification
Entry into Client Service Database
Sample Containers Shipped to Client
Sample Receipt
Sample Receiving
Log-in to LIMS
Generation of Master Data Folder
Project Manager Review
Client Notified of Sample Receipt
Lab Notified through Workload Tracking System
Laboratory Analysis
Laboratory QA Review
Sample and Extracts to Storage
Laboratory Data Reduction
Peer Review of Data
Data Transferred to LIMS
Submission of Data to QC Review
QC Review
Report Generation
Data Reports Submitted to Project Manager for Review
Data Package Compiled
Project Manager Final Review and Approval
Invoice Submitted to Accounting
Original Reports Signed and Delivered to Client
Copy of Final Data Package Archived

# Appendix H

# Analytical Methods

# ORGANIC ANALYSES

| Parameter | Methods | Technique |
|---|---|---|
| **Volatiles (GC/MS)** | 524.2/624/8260B | GC/MS |
| | Low Level Vinyl Chloride & 1,1 – Dichloroethene | GC-MS-SIM |
| **Volatiles (GC)** | | |
| Volatile Aromatics | 602/8021B | GC/PID |
| **Semivolatiles (GC/MS)** | | |
| Semivolatile Organics | 625/8270D | GC/MS |
| Polynuclear Aromatic Hydrocarbons (PNA/PAH) | 625/8270D | GC/MS (SIM) |
| Isotope Dilution Semivolatiles | 1625 | GC/MS |
| Butyl Tin Species | Krone (1988) | GC/MS-SIM |
| **Pesticides/GC Analyses** | | |
| Chlorinated Pesticides | 608/8081A | GC/ECD |
| Aroclors/PCBs | 608/8082 | GC/ECD |
| PCB Congeners | ARI Method | GC/ECD |
| Phenols | 604/8041 | GC/FID |
| Chlorinated Phenols | 8041 (mod) | GC/ECD |
| Pentachlorophenol | 8151A (mod) | GC/ECD |
| Organophosphorous Pesticides | 614/8141A | GC/NPD |
| Polynuclear Aromatic Hydrocarbons (PNA/PAH) | 610/8100 | GC/FID |
| Chlorinated Hydrocarbons | 612/8121 | GC/ECD |
| Herbicides | 615/8151A | GC/ECD |
| Glycols | ARI Method(SOP 426S R2) | GC/FID |
| Hydrocarbon ID | NWTPH-HCID | GC/FID |
| Gasoline Range Hydrocarbons | (N)WTPH-G/AK101/WI-GRO | GC/FID |
| Diesel Range Hydrocarbons | (NWTPH-D/AK102/WI-DRO) | GC/FID |
| Extractable Petroleum Hydrocarbons | ARI Method | GC/FID |
| Volatile Petroleum Hydrocarbons | ARI Method | GC/PID |
| **Organic Sample Preparation and Clean Up** | | |
| TCLP / SPLP Extraction | | 1311 / 1312 |
| Sonication | | 3550B |
| Soxhlet | | 3540C |
| Accelerated Solvent Extraction (ASE) | | 3545B |
| Separatory Funnel | | 3510C |
| Continuous Liquid-Liquid | | 3520C |
| Alumina Clean-up | | 3610B |

| | |
|---|---|
| Florisil Clean-up | 3620B |
| Gel Permeation (GPC) | 3640A |
| Silica Gel | 3630C |
| Sulfur Clean-up | 3660B |
| Sulfuric Acid Clean-up | 3665A |

# INORGANIC ANALYSES

| Parameter | Methods | Technique |
|---|---|---|
| **Wet Chemistry** | | |
| Acidity | 2310/305.1 | Titrimetric |
| Alkalinity | 2320/310.1 | Titrimetric |
| Ammonia | 4500$NH_3$H/350.1 | AutomatedPhenate/ISE |
| Biological Oxygen Demand-BOD | | |
| Carbonaceous – BOD | 5210.B/405.1 | 5-day Winkler Titration |
| Bromide | 4500Br.B | Phenol Red Colorimetric |
| Anions | 300.0 | Ion Chromatography |
| Cation Exchange Capacity | 9080 | Neutral Ammonium Acetate |
| Chemical Oxygen Demand | 5220.D/410.4 | Closed Reflux, Colorimetric |
| Chromium Hexavalent (Cr6+) | 3500Cr-D/7196A | Diphenylcarbazide |
| Chloride | 4500Cl.E/325.2 | Automated Ferricyanide |
| Chlorophyll a | 10200.H | Spectrophotometric |
| Coliform, Total / Fecal | 9222.B/D | Membrane Filtration |
| Color | 2120.B/110.2 | Visual Comparison |
| Conductivity | 2510/120.1 | Electrometric |
| Corrosivity (CaCO3 Saturation) | 2330 | Calc. (pH, Alk, TDS, Ca) |
| Cyanide, Total | 4500CN.C/335.2/9010 | PBA, Colorometric |
| Cyanide, Amenable | 4500CN.G/335.1 | Alkaline Chlorination |
| Cyanide, WAD | 4500CN.I | Weak Acid Distillation |
| Dissolved Oxygen | 4500-O.C/360.2 | Winkler Titration |
| Fats/Oils/Grease | 5520.B/413.1/9070A | Gravimetric |
| Fluoride | 4500F.C/340.2 | Ion Specific Electrode |
| | 300.0 | Ion Chromatography |
| Formaldehyde | ASTM D-19 P216 | Colorimetric |
| Hardness, Calculation | 2340.B/6010B | Ca, Mg Calculation |
| Heterotrophic Plate Count | 9215.D | Membrane Filtration |
| Iron (II) ferrous | 3500Fe.D | Phenanthrolene |
| Nitrate + Nitrite | 4500$NO_3$F/353.2 | Automated Cd Reduction |
| Nitrate | 4500$NO_3$F/353.2 | Calculated |
| | 300.0 | Ion Chromatography |
| Nitrite | 4500$NO_3$.F/353.2mod | Automated Colorimetric |
| | 300.0 | Ion Chromatography |
| Oil & Grease, Solids | 5520.D/907 | Gravimetric |
| Oil & Grease, Polar/Non Polar | 5520.F | Gravimetric |
| PH | 150.1 | Electrometric |
| Phenols | 5530.D/420.1/9065 | 4-AAP w/ Distillation |
| Phosphorous, Total | 4500P.B/365.2 | Colorimetric w/ digestion |

| | | |
|---|---|---|
| Phosphorous, Ortho (SRP) | 4500P.B/365.2 | Colorimetric |
| | 300.0 | Ion Chromatography |
| Salinity | 2520 | Conductimetric |
| Silicate | 4500Si.E/370.1 | Heteropoly Blue |
| Total Kjeldahl Nitrogen (TKN) | 4500N.org/351.4 | Block Digest/ISE |
| Total Solids | 2540.B/160.3 | Gravimetric, 104°C |
| Total Suspended Solids (TSS) | 2540.D.160.2 | Gravimetric, 104°C |
| Total Dissolved Solids (TDS) | 2540.C/160.1 | Gravimetric, 180°C |
| Total Volatile Solids (TVS) | 2540.E/160.4 | Gravimetric, 550°C |
| Settleable Solids | 2540.F | Volumetric |
| Streptococcus, Fecal | 9230.C | Membrane Filtration |
| Sulfide | 4500$S^2$.E/376.1/9034 | Iodometric |
| Sulfide, Low Level | 4500$S^2$.D/376.2 | Methylene Blue |
| Sulfide, Acid Volatile | 4500$S^2$.D/376.2 | Methylene Blue |
| Sulfate | 4500$SO_4^2$.F/375.2/9036 | Auto. Methylthymol Blue |
| | 300.0 | Ion Chromatography |
| Sulfite | 4500$SO_3^2$.B.377.1 | Iodometric |
| Total Organic Carbon (TOC) | 5310.B415.1/PSEP | Combustion NDIR |
| Turbidity | 2130.B/180.1 | Nephelometric |
| Total Lipids in Tissue | Bligh & Dyer (mod) | Gravimetric |

**Trace Metals Analyses**

**Inductively Coupled Plasma (ICP):**

| | | |
|---|---|---|
| Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Th, Ti, Tl, V, (Li, Th, U, W - special request only) | Zn200.7 / 6010B | ICP |

**Graphite Furnace (GFAA)**:

| | | |
|---|---|---|
| Ag, As, Cd, Sb, Pb, Se, Tl | 200 Series / 7000 Series | GFAA |

**Cold Vapor (CVAA):**

| | | |
|---|---|---|
| Hg | 7470A/7471A | CVAA |

**Inductively Coupled Plasma/Mass Spectroscopy (ICP-MS):**

| | | |
|---|---|---|
| Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Th, Tl, U, V, Zn | 200.8/ 6020 Mod. | ICP/MS |

**Trace Metals Sample Preparation**

| | |
|---|---|
| Toxicity Characteristic Leaching Procedure | 1311 |
| Synthetic Precipitation Leaching Procedure | 1312 |
| Digestion for Total Recoverable or Dissolved Metals | 3005A |
| Digestion of Aqueous Samples for Total Metals by ICP | 3010A |
| Digestion of Aqueous Samples for Total Metals by GFAA | 3020A |
| Digestion of Sediment, Sludge and Soil | 3050B |

# Appendix I

## Method Detection Limits
## Reporting Limits

Summaries of method specific MDL studies and reporting limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-CLs.zip

MDL's and reporting are updated periodically. Assure that you have ARI's current detection limit data by downloading the files at the time of use.

# Appendix J

# Quality Control Limits

Method specific control limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use.

# Appendix K

# Internal Audit Schedule

## Schedule of Laboratory Quality Assurance Audits

| Process To Be Audited | Frequency |
|---|---|
| Refrigerator/Freezer Temperature Logs | Monthly* |
| Oven/Incubator Temperature Logs | Monthly* |
| Balance Records | Quarterly* |
| Standard Records | Monthly# |
| Logbooks | Monthly# |
| SOPs | Monthly# |
| Chain of Custody | Monthly# |
| Internal Technical Systems | Annually |
| Post-Completion Project Review | Monthly** |

* all sections will be audited

# one section will be audited each month

** frequency may be contract specific i.e. 10% of NFESC projects must be audited

# Appendix L

# Laboratory Accreditations

## Laboratory Accreditations

Analytical Resources Inc. is currently certified to perform environmental analysis by the State of Washington Department of Ecology, the State of Washington Department of Health and selected other states. ARI has also been accredited to perform various analyses for HAZWRAP (Hazardous Waste Remedial Actions Program), NEESA (Naval Energy and Environmental Support Activity), and the Navy Clean program.

ARI's laboratory QA/QC Program has been audited and approved by the USEPA Contract Laboratory Program for both organic and inorganic, the U.S. Army Corps of Engineers, The Boeing Company and Battelle Northwest Laboratories.

ARI analyzes performance evaluation samples quarterly for the EPA-CLP Program and semiannually for the EPA Water Pollution (WP) and Water System (WS) series. Also, all ARI laboratories periodically analyze blind in-house Performance Evaluation Samples as part of the laboratory QA/QC Program.

### List of Accreditations

1) State of Washington, Department of Ecology - Environmental Laboratory Accreditation Program
2) The Alaska State Department of Environmental Conservation - Laboratory Approval Program
3) United States Army Corps of Engineers (US ACOE)
4) United States Naval Facilities Engineering Service Center (NFESC) (formerly known as NEESA)

### Continuing Contracts Resulting from On-Site Laboratory Audits

1) The Boeing Company Corporate Environmental Affairs Division
2) Battelle Northwest Laboratories
3) The City of Seattle
4) The Port of Seattle

# Appendix M

# Data Reporting Qualifiers

# Data Reporting Qualifiers

**Effective 12/28/04**

## Inorganic Data

U Indicates that the target analyte was not detected at the reported concentration

* Duplicate RPD is not within established control limits

B Reported value is less than the CRDL but ≥ the Reporting Limit

N Matrix Spike recovery not within established control limits

NA Not Applicable, analyte not spiked

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD

## Organic Data

U Indicates that the target analyte was not detected at the reported concentration

* Flagged value is not within established control limits

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J Estimated concentration when the value is less than ARI's established reporting limits

D The spiked compound was not detected due to sample extract dilution

NR Spiked compound recovery is not reported due to chromatographic interference

E Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.

S Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte

NA The flagged analyte was not analyzed for

NS The flagged analyte was not spiked into the sample

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a “tentative identification”

Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

C The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column

P The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference

## Geotechnical Data

A The total of all fines fractions. This flag is used to report total fines when only sieve analysis is requested and balances total grain size with sample weight.

F Samples were frozen prior to particle size determination

SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations

SS Sample did not contain the proportion of “fines” required to perform the pipette portion of the grain size analysis

W Weight of sample in some pipette aliquots was below the level required for accurate weighting

# Appendix N

# Standards for Personal Conduct

## Standards of Conduct

Since effective working relationships depend upon each of us, ARI expects certain minimum standards of personal conduct.

This list highlights general Company expectations and standards and does not include all possible offenses or types of conduct which may result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

Employees engaged in the following activities, or similar activities deemed equally serious, will normally be terminated:

theft or embezzlement
disclosure of trade secrets or industrial espionage;
willful violation of safety or security regulations;
conviction of a felony;
working for a competitor or establishing a competing business.

In addition, dismissal may result from other serious offenses such as:

being intoxicated, under the influence or in possession of illegal drugs on the job;
falsification of records;
abuse, destruction, waste or unauthorized use of equipment, facilities or materials;
gambling on the premises;
chronic tardiness or absenteeism;
insubordination;
unwillingness to perform the job;
unauthorized requisition of materials from vendors.

There may be no alcoholic beverages on the Company premises, other than at times designated as Company functions. At such times, non-alcoholic beverages will be provided as well.

Personal and corporate honesty and integrity have built the character of ARI. This good character is fundamental to our well-being, future growth and progress. It is vitally important that we avoid both the fact and the appearance of conflicts of personal interest with that of the firm, its clients, and any other professional contacts.

This policy requires that ARI employees have no relationships or engage in any activities that might impair their independence of judgment. Employees must not accept gifts, benefits, or hospitality that might tend to influence them in the performance of their duties. It is expected that there will be no employment by any competing company, nor any

employment by any outside interest or engagement in outside activity which might impair an employee's ability to render the full-time service to the company that employment involves.

If any possible conflict of interest situation arises, the individual concerned must make prior disclosure of the facts so that action may be taken to determine whether a problem exists and, if so, how best to eliminate it. Likewise, any financial interest in an organization doing business with ARI or which competes with us should be revealed to Company management. (Excluded from this requirement is ownership of securities traded in major stock exchanges or other recognized trading markets.)

Our standards are those generally expected of employees in any well-regarded, ethical business organization.

ARI further expects that each employee will:

Be dressed and groomed appropriately for a business office. Employees in the laboratory areas are expected to dress in compliance with established safety procedures. Specific standards will be discussed with each employee during Health and Safety orientation. Your supervisor and the Administrative Services Manager always are available to answer questions.

## Standards of Personnel Conduct – continued

Maintain the confidential nature of Company information. Removal of Company documents, records, stored materials, computer printouts, or any similar information, or copies of such material or information from the office without specific permission is prohibited. Likewise, revealing confidential information to an unauthorized person or using such information in an unauthorized way is prohibited. If there could be any possible question about the applicability of this requirement to a given circumstance, ask your supervisor.

Use Company computer capabilities and facilities only for authorized business at authorized times and locations; observe strictly all computer security measures and precautions; enter, alter or delete no computer instructions or stored material apart from that required by faithful performance of assigned duties; remove, copy, use or permit to be used no computer software developed for, purchased by, or otherwise used by ARI except as required by faithful performance of assigned duties.

Conduct business dealings with clients and members of the public in a courteous manner.

# Appendix O

# Quality Assurance Policies

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 1**

**SUBJECT: CORRECTIONS TO DATA/BENCHSHEETS**

**DATE: 8/2/96**

Manual corrections made on any raw data, bench sheet, logbook or document used during sample processing will be made in the following manner:

1. Draw a single line through the information to be deleted or corrected. The original information must remain readable.

2. Enter any new information, preferably above the original information.

3. Initial and date the correction.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 2**

**SUBJECT: LINING OUT UNUSED BENCHSHEET PORTIONS**

**DATE: 8/2/96**

All unused portions of logbook pages and benchsheets will be lined through so that information cannot be added at a later date. This will be completed in the following manner:

1. Line out unused portions of a logbook page or benchsheet by drawing a single line or "Z" through the unused portions.

2. Initial and date the page beside the lineout.

3. Do not line out a page or section until it is certain that no additional information will be added to the unused portions.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 3**

**SUBJECT: STOP WORK ORDERS**

**DATE: 8/28/96**

It is the responsibility of all staff members to address situations that may require the issuance of a "stop work order". Potential and actual "stop work orders" will be handled as follows:

1. If an analyst or technician observes a situation which will or may have a negative impact on data quality, that person will notify her/his section supervisor immediately.

2. The section supervisor will assess the situation. If it appears that a "stop work order" may be required, the section supervisor will notify the appropriate manager (inorganic or organic).

3. The supervisor and manager will then decide if a "stop work order" should be issued. The manager will make a final decision on whether or not to issue a "stop work order". The incident will be reported to the Quality Assurance Program Manager using a Corrective Action Request form.

4. If a "stop work order" is issued, the manager will inform the Project Managers and the QA section. The section supervisor will notify section staff of the order.

5. The laboratory manager involved will oversee the development and implementation of a Corrective Action Plan (CAP). Upon completion of the CAP the "stop work order" may be rescinded.

6. Prior to rescinding a "stop work order", verification must be made that control has been regained and that work may begin. Only the inorganic or organic manager may rescind a "stop work order".

7. When the "stop work order" is rescinded, the Project Managers, analytical staff and QA section will be notified. The QA section will require documentation verifying that the procedure is back in control.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 4**

**SUBJECT: SOP Review**

**DATE: 9/3/96**

All Standard Operating Procedure (SOP) documents will be reviewed and updated at least annually by qualified staff members. Laboratory management will review and approve all modifications to the SOPs.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER:** 5

**SUBJECT:** Reporting Dilutions

**DATE:** 9/11/96

Dilution factors will be recorded as whole numbers followed by "X" (i.e., 5X, 10X, etc.). This reporting convention will be used on run logs, bench sheets, raw data and final reports for all diluted samples, extracts or digestates or standards.

# QUALITY ASSURANCE POLICY

**POLICY NUMBER: 6**

**SUBJECT: Formatting for SOPs – Computer Related**

**DATE: 1/31/00**

Conventions for formatting computer-related instructions in SOPs

Commands should be indented and formatted as **`bold courier`** and one or two font sizes smaller:

```
USE PARAMS ORDER PARAMS
BROW
```

Many systems and languages are *case-sensitive*, and case should match the syntax and/or stylistic standards of the language.

If only one command, like ***SET CENTURY ON***, is needed, it can be included in the rest of the text, so long as it is also italicized.

If the user must substitute a particular value in place of a general descriptor, italicize the descriptor, make it lowercase, and *do not make it bold*:

```
USE PARAMS ORDER PARAMS
COPY TO TEMPARM FOR JOB = 'job' .AND. SAMPLE = 'sample'
```

In general, keywords, variable names, formatting codes, and descriptors should be in *`courier`* and *`italicized`*.

# QUALITY ASSURANCE POLICY

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|---|---|
| **POLICY NUMBER:** | **7** |
| **SUBJECT:** | **Manual Adjustment of Data** |
| **DATE of IMPLEMENTATION:** | **1/1/01** |

Modern chromatographic instruments include computer software to identify a detector response as a chromatographic peak, characterize that peak and determine the relative height or area of the signal. The software utilizes parameters (threshold, slope, etc) that are adjusted by the instrument operator to optimize the results.

A single set of operator controlled settings that determine peak characteristics for an entire data file is defined as an "automated procedure". An automated procedure often characterizes chromatographic peaks incorrectly. ARI requires that trained analysts identify and resolve these errors using an alternate automated procedure or a "manual adjustment" of the data. Manual adjustment is defined as the process used by an analyst to adjust an individual peak or a subset of data in a chromatographic file.

1. The settings for a routine automated procedure normally used to process chromatographic data must be described in the method Standard Operating Procedure (SOP).

2. Trained analysts may substitute one automated procedure for another in order to optimize peak characteristics. The use of an alternate automated procedure must be permanently documented using either a software generated log file or analyst notes.

3. Manual adjustment of chromatographic peak characteristics will be used to correct the results of an automated procedure that, in a trained analyst's opinion, are clearly incorrect and will result in erroneous peak identification, integration or quantification.

4. Manual adjustment will be implemented in a reasonable and consistent manner. Guidelines for performing manual adjustment will be documented in method SOPs.

5. All manually adjusted data will be clearly identified for approval in the data review process. A permanent record of all manual adjustments will be maintained in both electronic and hardcopy versions of the raw data.

6. Manual adjustment of chromatographic files will not be used to falsify data for any purpose. Falsification of data through the use of manual peak adjustment is unethical, unlawful and will result in termination of the offending analyst.

Approval:

_____

Quality Assurance Program Manager Date

# QUALITY ASSURANCE POLICY

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|---|---|
| **POLICY NUMBER:** | **8** |
| **SUBJECT:** | **Performance Evaluation Samples** |
| **IMPLEMENTATION DATE:** | **1/1/01** |

Performance Evaluation Samples (PES) will be analyzed on a periodic basis to monitor laboratory performance and/or meet the requirements of an external accreditation program. PES samples contain target analytes in concentrations unknown to laboratory personnel. PES may be submitted by a third party or prepared internally under the direction of ARI's QA personnel.

PES will be submitted blind to the laboratory whenever possible.

PES will be logged-in, prepared, analyzed and reported as a routine sample without special consideration.

# QUALITY ASSURANCE POLICY

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| **POLICY NUMBER:** | **9** |
| **SUBJECT:** | **Modifications to Analytical Methods Procedures or Reports** |
| **DATE of IMPLEMENTATION:** | **8/24/05** |

This Policy defines the processes used to initiate and validate modifications to analytical processes, QA/QC protocol, data processing programs and algorithms, data reporting formats or other changes to analytical procedures or SOPs at Analytical Resources Inc. (ARI). The procedures outlined will also be used to validate project specific changes to analytical protocol and new analytical methods.

Changes to analytical procedures must be approved by ARI's Management (Managers and/or Supervisors) and be well documented using the following procedure:

1. Modification may be requested by any staff member. The modification must be requested using ARI's Corrective Actions Tracking System. Corrective Action requests for changes to analytical protocol or reports will assigned to the appropriate manager or supervisor by the initiator. As an alternative the request may be assigned to the QA Section. The Corrective Actions assignee may approve the project or re-assign the request for approval to a third party. The QA Section will monitor the progress of all requests.

2. The requestor must detail and justify the proposed modifications or additions when initiating a Corrective Action issue. Modifications must be approved by ARI management prior to any work performed to establish the modification.

3. The following must be in place before final approval and/or implementation of the proposed modification.

A. A new or revised SOP as appropriate including the modification or new protocol.
B. An Initial Demonstration of Proficiency as defined in ARI SOP 1018S for new or modified analytical procedures.
C. An MDL study following the procedure in ARI SOP 1018S for new or modified analytical procedure.
D. When appropriate, successful analysis of a blind Performance Evaluation Sample using new or modified procedures or data processing protocol.
E. Documentation that new or modified software provides the desired result.

4. ARI staff must have sufficient training to implement the procedural changes.

5. Notification of the modifications must be distributed to all affected personnel including appropriate client personnel.

# QUALITY ASSURANCE POLICY

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| **POLICY NUMBER:** | **10** |
| **SUBJECT:** | **Reporting of Target and Spiked Analytes For Dual Column GC Analyses** |
| **DATE of IMPLEMENTATION:** | **8/24/05** |

Analytical Resources Inc. uses single injection, dual column gas chromatographs to simultaneously identify and confirm the presence of target or spiked analytes in some GC analyses. Only one quantitative value is reported for each target or spiked analyte. ARI's policy for deciding which value to report is outlined as follows:

1. ARI considers each column equally valid for compound identification and quantification. Both GC columns must be compliant with all quality assurance parameters outlined in ARI's SOPs and LQAP. Both GC columns must produce valid initial and continuing calibrations using the same calibration model.

2. The analytical value reported will be determined by comparison of the quantitative results of confirmed analytes as follows.

a. The relative percent difference (RPD) between the results on the two columns ($R_1$ & $R_2$) is calculated using the formula:

$$RPD = \frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} \times 100$$

b. If the RPD is less than 40% the greater of the two values is reported for both target analytes and spiked compounds. When required by specific QA protocol, by contract or client request the lower value will be reported for target analytes.

c. If the RPD is greater than 40%, ARI's analyst must examine the chromatogram for anomalies (overlapping peaks, incorrect integration, negative peaks) and either correct the anomalies (i.e. perform manual integrations) or report the most appropriate target analyte value. The higher value will be reported for spiked analytes. ARI's analyst must provide a written evaluation of all analyses where an RPD exceeds 40% and this information must be passed on to ARI's client or the data user.

# Appendix P

# Modifications to the LQAP

# Modifications to ARI's LQAP

| New Revision | Date | Modifications |
|---|---|---|
| 12-007 | 4/11/06 | 1. Removed Appendix J – Tuning Criteria are in the SOP<br>2. Changed BOD RL from 1 to 2 ppm<br>3. Integrated all SVOA Soil/Sediment MDLs into One Table<br>4. Added SIM Analysis to Soil/Sediment SVOA MDL Table<br>5. Added SIM Analysis to Water SVOA MDL Table<br>6. Updated MDL for SVOA in Water<br>7. Updated MDLV for Pesticides in Soil (25g to 5mL)<br>8. Updated MDLV for Pesticides in Soil (12g to 4mL)<br>9. Updated MDLV for PCB in Water (500 to 1mL)<br>10. Updated MDLV for PCB in Water (500 to 5mL)<br>11. Updated MDLV for Chlorinated Phenols in Water (500 to 50mL)<br>12. Removed Appendix I – MDL & RL Summaries<br>13. UpdatedMDL for SIM-PNA<br>14. Updated MDLV for SIM-PNA<br>15. Removed Appendix K – Control Limits |
| 12-006 | 1/16/06 | 1. Updated MDL for TBT in Pore Water<br>2. Updated MDL and MDLV for Toxaphene in Soil/Sediment<br>3. Updated MDLV for VOA 8260B 20 mL Purge<br>4. Added IDL, MDL & RL for Low RL Mercury<br>5. Updated all Metals MDL Verifications<br>6. Updated MDLV for Water VOA using 5 mL purge<br>7. Updated MDLV for PCB in Soil with Soxhlet Extraction<br>8. Updated MDLV for SVOA (8270D) Analysis of Water using SepFunnel<br>9. Updated MDL for GC-MS-SIM Analysis of Skydrol & BHT in Water<br>10. Updated MDL for Chlorophenols (8041) in Soil<br>11. Modified RL for Chlorophenols in Soil & Tissue<br>12. Added Headspace GC (FID5) to Instrument List<br>13. Updated Footnotes on Glycols RL Table<br>14. Modified RL for 1,4-Dioxane in Water Method 8270D<br>15. Updated MDL for Analysis of Soil for VOA<br>16. Updated MDL for Analysis of Soil for JP-8<br>17. Updated MDL for Analysis of Sediment for TBT<br>18. Updated MDLV for Analysis of TBT in Water and Tissue<br>19. Added MDL for Analysis of PCB in Tissue with 4 ppb RL<br>20. Updated MDLV for PCB Analysis of Soil (Soxhlet) and Tissue (4 ppb)<br>21. Updated MDLV for Manchester Analysis of PCB in Water<br>22. Updated MDLV for Analysis of Gasoline in Soil and Water<br>23. Updated MDLV for Analysis of BTEX in Soil and Water<br>23. Updated MDLV for Analysis of Motor Oil in Soil and Water<br>24. Upadted MDLV for Analysis of VOA-SIM in Water<br>25. Upadted MDLV for Analysis of VOA (20 mL) in Water<br>26. Updated MDL Table for Convntionals<br>27. Updated MDLV for Pesticides in Water (500 to .5 mL)<br>28. Updated MDLV for PCB Analysis of Soil<br>29. Updated MDLV for Chlorophenols (8041) in Soil<br>30. Updated MDLV for JP4 in Water and Soil<br>31. Updated MDLV for JP8 in Soil<br>32. Updated MDLV for VOA (8260B) in Water 5 mL & 20 mL Purge Volumes<br>33. Updated MDL for PCB in Soil – Standard Analysis & Medium Level<br>34. Updated MDL for Pesticides in Water – Standard Analysis<br>35. Updated MDL for SVOA in Water – Liq-Liq Extraction<br>36. Updated MDLV for Chlorophenols in Water |
| 12-005 | 10/24/05 | 1. Added MDL for Chlorinated Phenol Analysis of Tissue (Method 8041)<br>2. Modified QA Policy 10 |

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| | | 3. Established Implementation Date for QA Policies 09 & 10<br>4. Updated MDLV for TBT in Water<br>5. Corrected MDL Value for bis-(2-Ethylhexyl)-phthalate in SVOA Tissue<br>6. Updated MDL for Pesticides in Soil<br>7. Modified Title Format of Selected MDL Tables<br>8. References to 8270 or 8270C changed to 8270D<br>9. Deleted MDL Tables for SVOA Analyses of Tissue<br>10. Updated MDLs for SIM-PNA in Water (SepFunnel) and Soil<br>11. Updated MDLV for Metals<br>12. Updated MDLV for Manchester Pesticides<br>13. Updated MDLV for TPH-D In Soil<br>14. Updated MDLV for SIM-PNA in Water with Liq-Liq Extraction<br>15. Updated MDLV for JP-4 in Soil<br>16. Updated MDLV for VOA Water 5 mL Purge<br>17. Corrected MTCA RL for Methoxyclor & Manchester RL for all Pesticides<br>18. Updated MDL for Manchester Beta-BHC to reflect latest MDLV<br>19. Corrected Tissue Pesticide RLs<br>20. Updated MDLV for LVI-SIM-PNA in Water with Liq-Liq Extraction<br>21. Updated MDL for VOA-SIM Analysis of Aqueous Samples<br>22. Updated MDLV for PCB in Water (500 to 5 mL)<br>23. Updated MDLV for Diesel in Water (NWTPH-D & AK102)<br>24. Updated MDLV for Chlorophenols in Aqueous Samples<br>25. Updated MDLV for Chlorophenols in Tissue Samples<br>26. Removed & Archived Modifications to LQAP for 2002 & 2003<br>27. Updated MDL for Skydrol/BHT Analysis in Water Using 8270-SIM<br>28. Removed Direct Aqueous Injection MDLs RL Table.<br>29. Updated SOP Table (Appendix E) |
| 12-004 | 8/19/05 | 1. Added “A” Flag for GeoTech to Appendix N.<br>2. Updated MDL for JP-4 in Soil<br>3. Updated MDL for Pesticides in Tissue<br>4. Updated MDLV for JP-4 in Soil<br>5. Updated MDLV for Pesticides in Soil<br>6. Updated MDLV for Pesticides in Water<br>7. Updated MDLV for PCB in Soil (25g to 1 mL)<br>8. Updated MDLV for PCB in Water (500 to 5 mL)<br>9. Updated MDLV for TPH-D in Water<br>10. Updated MDLV for PNA-SIM in Water (Liq-Liq Extraction)<br>11. Updated MDLV for VOA in Water (5 mL 8260B)<br>12. Updated MDLV for VOA in Water (20 mL 8260B)<br>13. Updated MDL for PSDDA SVOA in Sediment<br>14. Updated Appendix E – SOP List<br>15. Corrected MDL for Pesticides in Soil Information (IA-80 not GU-32)<br>16. Corrected Reporting Limits for TBT in Water, Sediment & Tissue<br>17. Added Control Limits for 1,4-Dioxane to SVOA List<br>18. Added low level RLs for BTEX Compounds<br>19. Updated MDLV for TBT in Pore Water<br>20. Updated MDLV for BTEX Water & Soil<br>21. Updated MDLV for TPH-G in Water & Soil<br>22. Updated Appendix E SOP Table<br>23. Updared MDLV for Motor Oil in Soil Using ASE<br>24. Updared MDLV for Motor Oil in Soil Using MicroTip<br>25. Updared MDLV for Motor Oil in Water Using SepFunnel<br>26. Updared MDLV for JP-4 in Water Using SepFunnel |
| 12-003 | 7/15/05 | 1. Added MDLV for 5 mL VOA Analysis of Water – Method 8260B<br>2. Updated MDL for MTCA PCB in Water Samples<br>3. Added MDL for Soxhlet Extraction of PCBs<br>4. Removed Aroclor 1242 from MDL Table |

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| | | 5. Control Limits for HEM Changed to Equal Those in SOP 648S<br>6. Updated MDL for PSDDA PCB Analysis.<br>7. Added MDL for TBT in Tissue<br>8. Updated MDL for 20 mL 8260B<br>9. Updated MDLV for SIM-VOA<br>10. Updated MDL for Pesticides in Soil<br>11. Updated MDLV for TPH-D in Soil<br>12. Added MDLV for PSEP Level Pesticides in Sediment<br>13. Updated (added missing compounds) PSDDA SVOA MDLs<br>14. Updated & Corrected Appendix F (Containers & Preservatives)<br>15. Added "A" Flag for GeoTech to Appendix N. |
| 12-002 | 6/9/05 | 1. Updated Motor Oil MDL (NWTPH-Dext & AK103) for Soil<br>2. Documented MDLV for Gasoline in Soil (Methods NWTPH-G & AK101)<br>3. Corrected units for DRO & RRO MDL for water from mg/kg to mg/L<br>4. Added MDL for JP-4 in Water using Sep Funnel Extraction<br>5. Updated MDL for Sediment Analysis (Krone) of TBT using Sonication<br>6. Updated MDL for SVOA Water SepFunnel<br>7. Noted that BTEX –SIM MDL in Table was Medium Level Extraction<br>8. Added MDL Verification Information for ICP Metals<br>9. Updated MDL for TBT in Water and Pore Water – SepFunnel<br>10.Updated MDLV for TPH-D Water – SepFunnel<br>11. Added EPH and VPH RL Tables<br>12. Added MDLV for JP-4 Analysis of Water – Sep Funnel<br>13. Added MDLV for BTEX analysis of Soil<br>14. Added MDLV for SVOA Water - SepFunnel<br>15. Added MDLV for TBT Sediment<br>16. Updated MDL for PSEP Pesticides in Sediment/Soil<br>17. Updated MDL for Chlorinated Phenols in Water<br>18. Updated MDL for Pesticides in Water – SepFunnel<br>19. Added MDLV for 524.5<br>20. Added MDLV for Metals<br>21. Updated MDL for Manchester Pesticides<br>22. Added Appendices to the Table of Contents<br>23. Added MDL for PCB Analysis of Tissue |
| 12-001 | 4/5/05 | 1. List of SOPs (Appendix E) Modified & Updated as Appropriate<br>2. MDL Verification for DRO in Soil Added<br>3. MDL Verification for PCB Water Standard Analysis (HO-24) Added<br>4. AK-101 Removed from BTEX MDL Table for Water<br>5. Metals IDLs & MDLs Updated<br>6. BTEX MDL for Analysis of Water and Soil Updated<br>7. RL for 1,4-Dioxane in SVOA Analysis of Water Changed from 1.0 to 5.0<br>8. Control Limits for BTEX and Gasoline updated<br>9. MDL for Gasoline in Soil Updated<br>10.MDL for Diesel and Motor Oil in Soil Updated.<br>11. Split TPH-G Table into Aqueous and Soil Table & added MDLV for Water<br>12. Entered updated MDLs for SIM-LVI-PNA<br>13. Changed RL for 20 mL 1,2-Dibromo-3-Chloropropane from 2 to 0.5 ppb<br>14. Updated MDLs for 524.2<br>15. Updated Conventionals MDLs<br>16. Updated MDLs for 5 mL VOA analysis of Water Samples (8260B)<br>17. Modified MDL Table for TPH-D Analysis of Water<br>18. Updated TPH-D and TPH-Dext MDL for Water Analyses.<br>19. Removed EPH and VPH MDLs from the LQAP |
| 11-028 | 12/31/04 | 1. Modified definition of "Y" flag in Appendix N<br>2. Updated MDL for TPH-D Soil<br>3. Updated Appendix M - Laboratory Certification and Accreditation |
| 11-027 | 12/15/04 | 1. Updated SOP List in Appendix E. |

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| | | 2. Added AK-101 to BTEX/GRO Control Limit Table.<br>3. Lowered RL for Benzene in MDL Summary for Method 8021B<br>4. Added Additional Surrogates to VOA-SIM BTEX Control Limit Table<br>5. Corrected BTEX MDLs for 8260-SIM to Reflect Sample Conc. Not On-Column values<br>6. Updated SOP Table in Appendix E<br>7. Modified VOA 5 mL Water RLs - Acrylonitrile & 1,2,3-Trichloropropane<br>8. Modified VOA mL Soil RL – 4-Methyl-2-Pentanone<br>9. Corrected MDL Value for Methoxychlor in PSDDA Sediment Analysis.<br>10.Modified definition of "Y" Flag in Appendix N<br>11.Updated MDL for BTEX Water PID-2<br>12.Updated MDL for Pesticides MTCA Analysis of Water<br>13.Updated MDL for PSDDA SVOA Analysis<br>14.Updated MDL for VOA Soil<br>15.Updated MDL for SVOA, Water, Liq-Liq<br>16.Updated MDL for Various PCB (1660) Analyses<br>17.Updated MDL for TPH-G – Water & Soil<br>18.Updated MDL for SVOA Soil Micro Sonication<br>19.Added MDL for Manchester Aroclor 1254<br>20.Modified Control Limits for EPH Analyses<br>21.Deleted MDL Table for SVOA, Soil, MacroTIp Extraction<br>22.Deleted MDL for Soil Skydrol/BHT, GC-MS-SIM<br>23.Updated Instrumentation Listing (Appendix D) |
| 11-026 | 11/02/04 | 1. Updated Control Limits for SIM-PNA<br>2. Added Control Limit Table for Full Scan PNA Analysis (Method 8270D)<br>3. Updated SIM-PNA Water MDL for NT-1<br>4. Updated Appendix E – SOPs<br>5. Modified PCB MDL Table –Remove Manchester & Combine PSEP/Low Level Sediment MDLs<br>6. Updated MDL for VOA SIM Water NT3<br>7. Updated MDL Table for SIM Skydrol/BHT in Water<br>8. Updated SOP Table in Appendix E. |
| 11-025 | 9/16/04 | 1. Added new Appendix N listing Data Qualifiers & changed designations for Appendices N, O & P to O,P & Q respectively<br>2. Updated MDL Table for PCB Analyses.<br>3. Combined MDL tables for SVOA Water & Deleted Sep Funnel Table<br>4. Updated PCB & TPH-D MDL Tables<br>5. Updated Equipment List (Appendix D) & added GeoTech Equipment<br>6. Revised MDL Table for FID Analysis of Polar SVOA (EPA Method 8015)<br>7. Updated MDLs for Pesticide analysis of soil.<br>8. Sediment Pesticide MDLs added to Soil Table, Sediment Table Deleted<br>9. Control Limit for MS Recovery of Pyrene in Sediment Corrected<br>10.Updated Cyclohexanone MDL (Finn 1, 20 mL purge)<br>11.Updated SIM-PNA Soil MDL for NT-1<br>12. Edited MDL Tables for SVOA for consistency and accuracy<br>13. Modified EPH Reporting Limits<br>14. Revised formatting on most MDL tables.<br>15. Corrected dates for VOA Control Limit data<br>16. Deleted analytes except cyclohexanone from VOA MDL Table for Project Specific Analytes.<br>17. Added BTEX in Soil to VOA-SIM MDL Table<br>18. Added Manchester MDL to PCB Table<br>19. Updated Skydrol/BHT Control Limits |
| 11-024 | 7/19/04 | 1. Revised and Updated MDL Tables for TPH Analyses of Soil/Sediment.<br>2. Revised and Updated MDL Tables for PCB Analyses. Combined All PCB MDL into One Table.<br>3. Deleted all other MDL tables |

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| | | 4. Updated MDL for VOA analysis of Soil using ARI's In-house Method.<br>5. Added 1-Methylnaphthalene to SIM-PNA MDL Tables for Water & Soil<br>6. Updated Appendix D (Lab Equipment) and added GeoTech Section<br>7. Combined Water & Soil SIM-PNA MDL Tables into One Table<br>8. Deleted Water-SF & Soil SIM-PNA MDL Tables<br>9. Updated MDLs for Pesticide – Manchester Extraction<br>10. Revised VOA Water Control Limits Table<br>11. Updated MDLs for VOA analysis of Water-8260B-5mL purge |
| 11-023 | 7/6/04 | 1. Corrected Conventionals MDL/RL Table<br>2. Corrected Control Limit for TPH-D MS Recovery in Water Samples.<br>3. Updated MDLs for NWTPH-D Soil ASE & MicroTip.<br>4. Removed HPLC MDL Table for analysis of PNA.<br>5. Removed MDL Table for HCID<br>6. Removed FID-3B from TPH MDL Tables<br>7. Updated MDLs & Modified Table for SVOA-PSEP analysis of Sediments<br>8. Revised Section 11<br>9. Updated MDL for VOA (524.2) analysis of Water<br>10. Removed MDLs for VOA-SIM analysis of Soil<br>11. Updated MDL Table for VOA-Water 20 mL<br>12. Updated MDL Table for VOA-Water 5 mL |
| 11-022 | 5/17/04 | 1. Corrected Extract Final Volume in MDL table for Sediment PCB<br>2. Deleted FINN 8 from all MDL Tables<br>3. Corrected RL for Hg in Water. |
| 11-021 | 5/07/04 | 1. Implemented default control limits for EPA Method 524.2<br>2. Decreased RL for Aroclor 1221 to level of other Aroclors<br>3. Eliminated Control Limits for VOA using ARI SOP 804S.<br>4 Updated VOA 8260B full scan control limits for water & sediment/soil<br>5. Updated 10 mL purge VOA-SIM control limits for water<br>6. Changed effective date for VOA-SIM BTEX control limits<br>7. Updated 8270-SIM-PNA control limits for water & sediment/soil<br>8. Updated BTS control limits for water & soil. |
| 11-020 | 4/26/04 | 1. Updated MDL (PID1 & 2) for BTEX in water<br>2. Updated MDL (PID 1) for gasoline in water<br>3. Deleted MDL Table for ASE extraction of chlorinated pesticides<br>4. Updated MDL for VOA water 5 mL purge 8260B on NT3<br>5. Updated MDL for pesticide in water separatory funnel on ECD3<br>6. Added MDL Table for VPH in water and soil<br>7. Deleted Control Limit Table for HPLC PNA<br>8. Updated PCB control limits<br>9. Updated Herbicide control limits<br>10. RL for Sulfate to 2.0 & 20.0 ppm for water & solids respectively<br>11. Updated TPH-D Control Limits<br>12. Updated Chlorinated Phenols Control Limits<br>13. Updated BTEX & TPH-G Control Limits<br>14. Corrected Pesticide MTCA MDL Table<br>15. Corrected RL for GC-ECD analyses of HCBD & HCB |
| 11-019 | 3/11/04 | 1. Revised holding time for Total Solids in soil & sediment from 7 days to 14 days.<br>2. Updated MDLs for SVOA water L/L NT4 & NT 6.<br>3. Updated Metals IDLs and MDLs<br>4. Added QA Policy 9 – Modifications to method, protocol or reports<br>5. Updated Conventionals MDLs<br>6. Added QA Policy 10 – Reporting of dual column GC analytes |
| 11-018 | 1/21/04 | 1. Revised Control Limits for GC-MS analysis of SVOA<br>2. Revised Control Limits for Chlorinated pesticides<br>3. Updated Appendix E – Table of SOPs<br>4. Updated and Revised Appendix F – Sample Containers, Preservation and |

| | | |
|---|---|---|
| | | Holding Times<br>5. Modified Sign-of Sheet to include only QA manager |
| 11-017 | 1/4/04 | 1. Minor revisions to Section 13<br>2. Revisions to subcontracting language in Section 6.3 |

# Pacific Groundwater Group

## HEALTH AND SAFETY PLAN
## Ephrata Landfill, Ephrata, Washington

Revised:8/1/07

**Job No.** JE0714a

**Name of Site:** Ephrata Landfill, property owner is Grant County

**Address of Site:** 4002 Road 13 NW, Ephrata, WA 98823

**Client:** Grant County

**Site Contact:** (509) 754-6082 Derek Pohle or Janice Goeden
(509) 754-4319 Ephrata Landfill

**Site Activities Planned:** Soil Sampling by backhoe and borings; installing monitoring wells and collecting groundwater samples

| Activity | Location | Date |
|---|---|---|
| Soil sampling in test pits | NW corner of Ephrata landfill | August 13-24, 2007 |
| Soil sampling from borings | NW corner of Ephrata landfill | Sept. 10-20, 2007 |
| Install and sample groundwater monitoring wells | Ephrata landfill | Sept. 20-30, 2007 |

**Estimation of Direct Exposure Hazard to Pacific Groundwater Group Personnel**

High___ Medium_X__ Low____ None___

**Physical Description of the Facility (attach map):**

parking lot and dirt/gravel roads; flat and/or hilly area of covered refuse

**Operational Description of the Facility:**

delivery of refuse by medium-sized and large-sized trucks; gently rolling to flat topography

**Site Status**

Active ☒ Inactive ☐ Abandoned ☐ Unknown ☐

# PGG HEALTH AND SAFETY PLAN
# Ephrata Landfill, Ephrata, Washington

**HAZARD ASSESSMENT**

| | | | | | |
|---|---|---|---|---|---|
| **Chemical State:** | Liquid ☒ | Solid ☒ | Gas ☒ | Unknown ☐ | Other ☐ |
| | In soil | In soil | | | |
| **Chemical Characteristics:** | | | | | |
| Corrosive ☒ | Flammable ☒ | Toxic ☒ | Volatile ☒ | Inert ☒ | Other ☐ |

**List the Chemicals of Concern:**

| Chemical Name | Physical/Chemical Characteristics | Regulatory Standards | Exposure Routes/Symptoms |
|---|---|---|---|
| 1,2-Dichloroethane (EDC) | Colorless liquid with a pleasant, chloroform-like odor. | OSHA PEL = TWA 50 ppm, C 100 ppm | ***Exposure Routes***<br>inhalation, ingestion, skin absorption, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen] |
| 1,1-Dichloroethane | Colorless, oily liquid with a chloroform-like odor. | OSHA PEL = TWA 100 ppm | ***Exposure Routes***<br>inhalation, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation skin; central nervous system depression; liver, kidney, lung damage |
| Chloroethane | Colorless gas or liquid (below 54°F) with a pungent, ether-like odor. | OSHA PEL = TWA 1000 ppm | ***Exposure Routes***<br>inhalation, skin absorption (liquid), ingestion (liquid), skin and/or eye contact<br><br>***Symptoms***<br>Incoordination, inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage |
| Tetrachloroethene (PCE) | Colorless liquid with a mild, chloroform-like odor. | OSHA PEL = TWA 100 ppm, C 200 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen] |
| Trichloroethene (TCE) | Colorless liquid (unless dyed blue) with a chloroform-like odor. | OSHA PEL = TWA 100 ppm, C 200 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact |

| | | | |
|---|---|---|---|
| | | | ***Symptoms***<br>Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen] |
| 1,1-Dichloroethene | Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor. | OSHA PEL none | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen] |
| cis-1,2-Dichloroethene | No data available | No data available | No data available |
| trans-1,2-Dichloroethene | No data available | No data available | No data available |
| Vinyl Chloride | Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations. | OSHA PEL = TWA 1 ppm, C 5 ppm | ***Exposure Routes***<br>inhalation, skin, and/or eye contact (liquid)<br><br>***Symptoms***<br>Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen] |
| Chloromethane | Colorless gas with a faint, sweet odor which is not noticeable at dangerous concentrations. | OSHA PEL = TWA 100 ppm, C 200 ppm | ***Exposure Routes***<br>inhalation, skin and/or eye contact (liquid)<br><br>***Symptoms***<br>Dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects; [potential occupational carcinogen] |
| Dichloromethane (Methylene Chloride) | Colorless liquid with a chloroform-like odor. [Note: A gas above 104°F.] | OSHA PEL = TWA 25 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, skin; lassitude |

| | | | |
|---|---|---|---|
| | | | (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential occupational carcinogen] |
| Trichlorofluoromethane | Colorless to water-white, nearly odorless liquid or gas (above 75°F). | OSHA PEL = TWA 1000 ppm | ***Exposure Routes***<br>inhalation, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Incoordination, tremor; dermatitis; cardiac arrhythmias, cardiac arrest; asphyxia; liquid: frostbite |
| 1,2-Dichloropropane | Colorless liquid with a chloroform-like odor. [pesticide] | OSHA PEL = TWA 75 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, skin, respiratory system; drowsiness, dizziness; liver, kidney damage; in animals: central nervous system depression; [potential occupational carcinogen] |
| Benzene | Colorless to light-yellow liquid with an aromatic odor. [Note: A solid below 42°F.] | OSHA PEL = TWA 1 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen] |
| Toluene | Colorless liquid with a sweet, pungent, benzene-like odor. | OSHA PEL = TWA 200 ppm, C 300 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage |
| Ethyl benzene | Colorless liquid with an aromatic odor. | OSHA PEL = TWA 100 ppm | ***Exposure Routes***<br>inhalation, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, skin, mucous |

| | | | |
|---|---|---|---|
| | | | membrane; headache; dermatitis; narcosis, coma |
| Xylene (m, p, o) | Colorless liquid with an aromatic odor. | OSHA PEL = TWA 100 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis |
| 1,2-Dichlorobenzene | Colorless to pale-yellow liquid with a pleasant, aromatic odor. | OSHA PEL = C 50 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, nose; liver, kidney damage; skin blisters |
| 1,4-Dichlorobenzene | Colorless or white crystalline solid with a mothball-like odor. [insecticide] | OSHA PEL = TWA 75 ppm | ***Exposure Routes***<br>inhalation, skin absorption, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Eye irritation, swelling periorbital (situated around the eye); profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; in animals: liver, kidney injury; [potential occupational carcinogen] |
| Bis(2-ethylhexyl) Phthalate | Colorless, oily liquid with a slight odor. | OSHA PEL = TWA 5 $mg/m^3$ | ***Exposure Routes***<br>inhalation, ingestion, skin and/or eye contact<br><br>***Symptoms***<br>Irritation eyes, mucous membrane; in animals: liver damage; teratogenic effects; [potential occupational carcinogen] |
| | | | |

**Hazards of Concern:**

Heat Stress ☒ Cold Stress ☐ Explosive/Flammable ☒ Oxygen Deficient ☐

Excessive Noise ☐ Inorganic Chemicals ☒ Organic Chemicals ☒ Other ☐

**Describe Potential Environmental Hazards:**

Exposure to chemicals of concern.

**Describe Potential Worker Hazards:**

Potential hazards include:

- Falling and tripping hazards
- Working adjacent to moving vehicles and heavy equipment

# PGG HEALTH AND SAFETY PLAN
# Ephrata Landfill, Ephrata, Washington

## ACTIVITY CONSIDERATIONS

**Will site representative be present?** Yes ☒ No ☐ A site representative may not be present after 3 pm during the period of drilling.

**Exact location of chemicals:** Known ☐ Assumed ☐ Unknown ☒

**Identify nearest offsite population and describe:** Residential ☐ Industrial ☒ Rural ☐ Urban ☒

Site is located in a light industrial area and ~3 miles south of the city of Ephrata.

## SAFETY CONSIDERATIONS

**If there is more than one level of hazard, or if there are multiple "sites" within a site, a separate page should be completed to show specific safety considerations for each location.**

Site location:

4002 Road 13 NW, Ephrata, WA 98823

**Objective of Work at this Location:** To collect soil samples for analysis to investigate possible contamination.

**Level of Protection Planned:** C ☐ D ☒

**Possible Modifications:** Move out of direct breathing of volatile organics during sampling.

**Monitoring Equipment:**

PID ☒ $0_2$ Meter ☐ Explosimeter ☒ $H_2S$ Meter ☒ Other Visual ☐

**Action Levels:**

PID: move away from test pit area into fresh air if PID reading is greater than 5 ppm or background established for the parking lot.

Explosimeter: move away from test pit area into fresh air if explosimeter reading is greater than 5% by volume LEL.

$H_2S$ Meter: move away from test pit area into fresh air if $H_2S$ meter reading is greater than 10 ppm.

**Type of Personal Protective Equipment to be Used:**

**NOTE: ALL PERSONS ON SITE MUST WEAR HARD HATS, SAFETY GLASSES, AND STEEL-TOE BOOTS DURING DRILLING or BACKHOE EXCAVATION.**

| | |
|---|---|
| Head: | Hard hat if heavy equipment is onsite |
| Foot: | Steel toe boots if heavy equipment is onsite |
| Hand: | Chemical resistant gloves (during all soil sampling and drilling) |
| Eye/Face: | Eye protection when working near active drill rig. |
| Clothing: | Coveralls or appropriate work clothes |
| Respiratory: | PID, explosimeter, and $H_2S$ monitoring; move out of elevated airspace |
| Additional Gear: | Noise protection when noise levels exceed 85 decibels. |

**Work Party:**

| Name of Personnel | Responsibility | Level of Protection |
|---|---|---|
| Dawn Chapel | Assistant Project Manager | Level D |
| Jeff Witter | Sampler | Level D |
| Charles Ellingson | Project Manager | Level D |

**Safe Entry Procedures:** WEAR APPROPRIATE PPE

**Criteria for Changing Protection:**

We will change to PPE level C if highly contaminated materials are encountered. For example, if we encounter strong odors and/or soils saturated with hazardous liquids.

**Decontamination Procedures:**

Disposable PPE will be removed at the end of each day and disposed of as nonhazardous waste unless grossly contaminated.

Work boots in contact with site soils should be brushed off while at the site.

**Work Limitations (time of day, conditions, etc.):**

**WORK WILL BE LIMITED TO DAYLIGHT HOURS.**

# PGG HEALTH AND SAFETY PLAN
# Ephrata Landfill, Ephrata, Washington

**Locations of Nearest:**

Phone: A cellular telephone will be used by field personnel..
Running Water Source: NW corner of landfill near maintenance shop
Public Road: State Route 28
Rest Room: NW corner of landfill near maintenance shop

**EMERGENCY PLANNING**

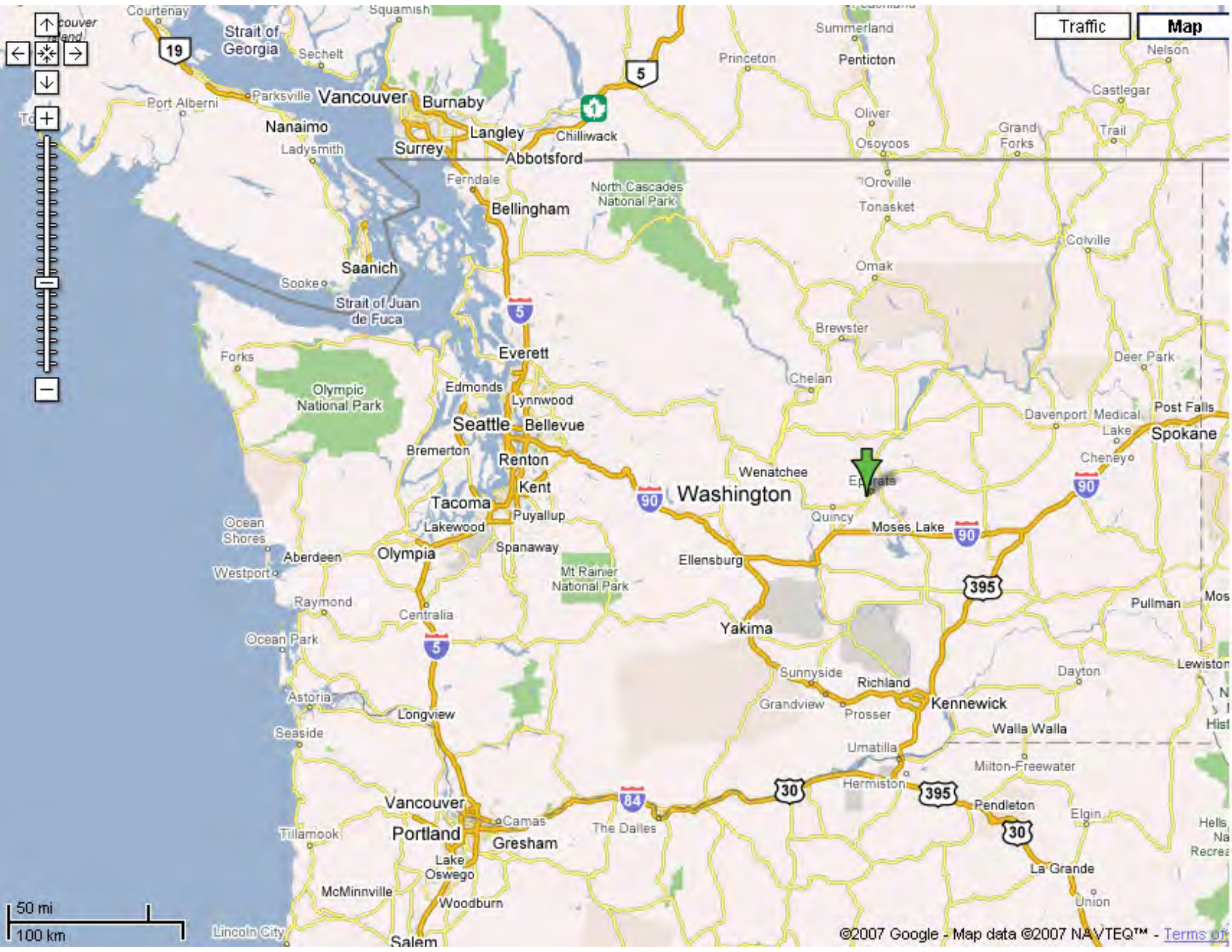
| Name | Contact Person | Phone Number |
|---|---|---|
| Local Police: | | 911 |
| Local Ambulance: | | 911 |
| Local Fire Department: | | 911 |
| Poison Control Center: | | 911 |
| Local Hospital: | Columbia Basin Hospital | Hospital Switchboard (509) 754-4631 |
| Address: | 200 Nat Washington Way Ephrata, WA 98823 | |
| Ecology: | | |
| Project Manager: | Charles Ellingson | (206) 329-0141 |

**Provide Directions to Nearest Available Medical Facility (attach map):**

Head west out of landfill to Washington State Hwy 28. Turn right and head north on Hwy 28 towards Ephrata. Travel 3.1 miles and once In Ephrata, turn right onto 3rd Ave SW. Proceed 0.1 miles and continue on Nat. Washington Way for 0.4 miles until you reach the hospital.

| Approvals | Date | Signature |
|---|---|---|
| Sampler: | | |
| Sampler: | | |
| Sampler: | | |
| Site Safety Officer: | | |
| Project Manager: | | |

cc: Project File


Traffic
Map
Courtenay
Squamish
Strait of Georgia
Sechelt
19
Vancouver
Burnaby
Port Alberni
Parksville
Nanaimo
Ladysmith
Langley
Surrey
Chilliwack
5
Abbotsford
Ferndale
Bellingham
Princeton
Summerland
Penticton
Nelson
Castlegar
Oliver
Osoyoos
Grand Forks
Trail
Oroville
Tonasket
North Cascades National Park
Colville
Omak
Saanich
Sooke
Strait of Juan de Fuca
Everett
Brewster
Deer Park
Forks
Olympic National Park
Edmonds
Lynnwood
Seattle
Bellevue
Chelan
Davenport
Medical Lake
Post Falls
Spokane
Cheney
Bremerton
Renton
Wenatchee
Kent
Tacoma
Puyallup
90
Washington
Quincy
Moses Lake
Ocean Shores
Lakewood
Aberdeen
Olympia
Spanaway
Westport
Ellensburg
Mt Rainier National Park
395
Pullman
Raymond
Centralia
Yakima
Ocean Park
Sunnyside
Richland
Dayton
Lewiston
Astoria
Grandview
Prosser
Kennewick
Longview
Seaside
Walla Walla
Umatilla
Milton-Freewater
Hermiston
30
Vancouver
84
Camas
The Dalles
Pendleton
Elgin
Tillamook
Portland
Gresham
La Grande
Lake Oswego
McMinnville
Woodburn
Union
Lincoln City
Salem
50 mi
100 km
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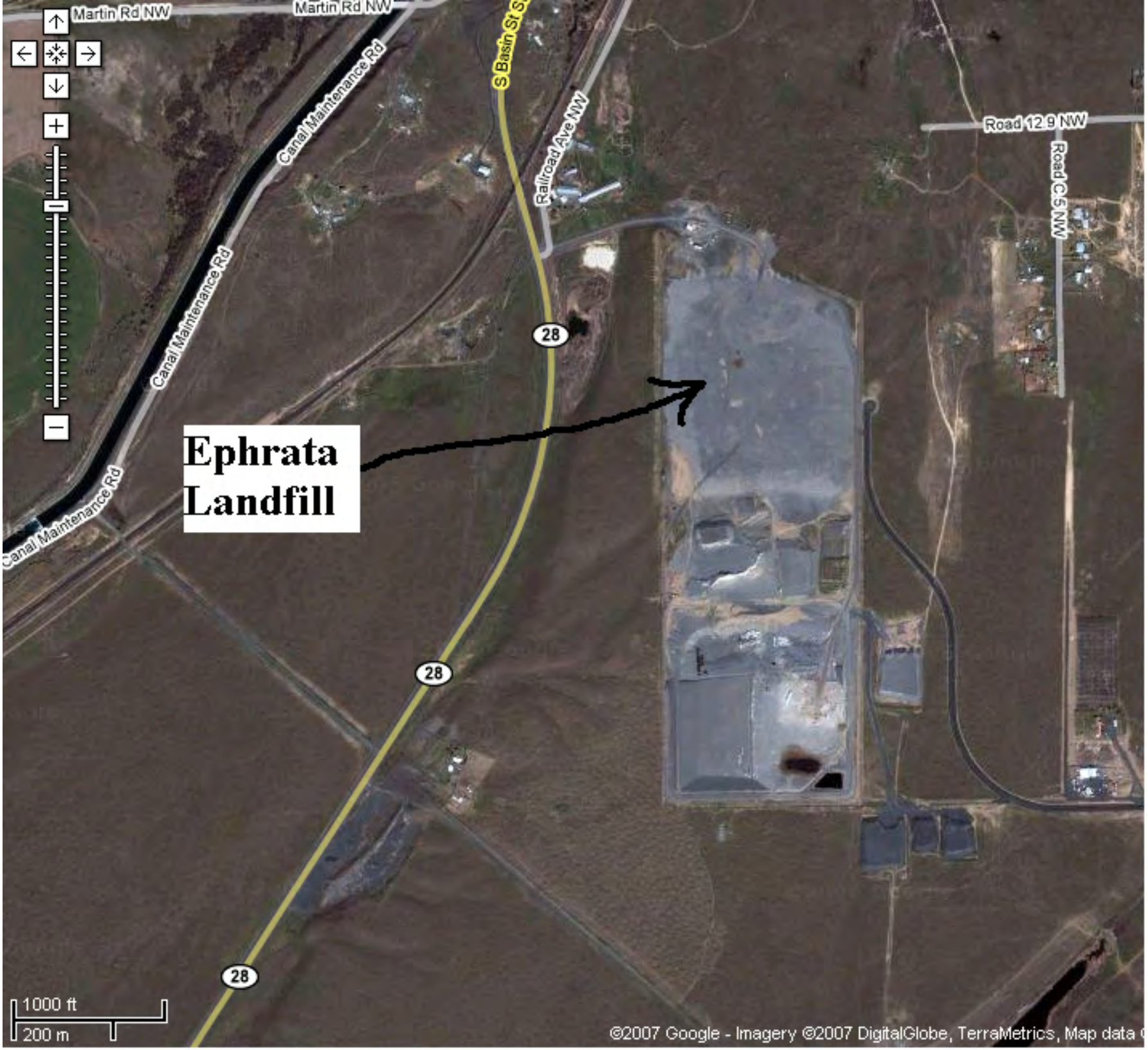
Sagebrush Flats Rd NW
1st Ave NW
28
Ephrata
S Basin St NW
Nat Washington Way
Road C NW
282
28
Road C NW
282
Ephrata
Landfill
28
Naylor
Road C NW


Martin Rd NW
Martin Rd NW
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Canal Maintenance Rd
S Basin St
Railroad Ave NW
Road 12.9 NW
Road C.5 NW
28
28
28
Ephrata
Landfill
1000 ft
200 m
©2007 Google - Imagery ©2007 DigitalGlobe, TerraMetrics, Map data


Sagebrush Flats Rd NW
1st Ave NW
Basin St NW
28
Ephrata
Alder Street
Nat Washington Way
282
Road C NW
Hospital
Ephrata Lanfill
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